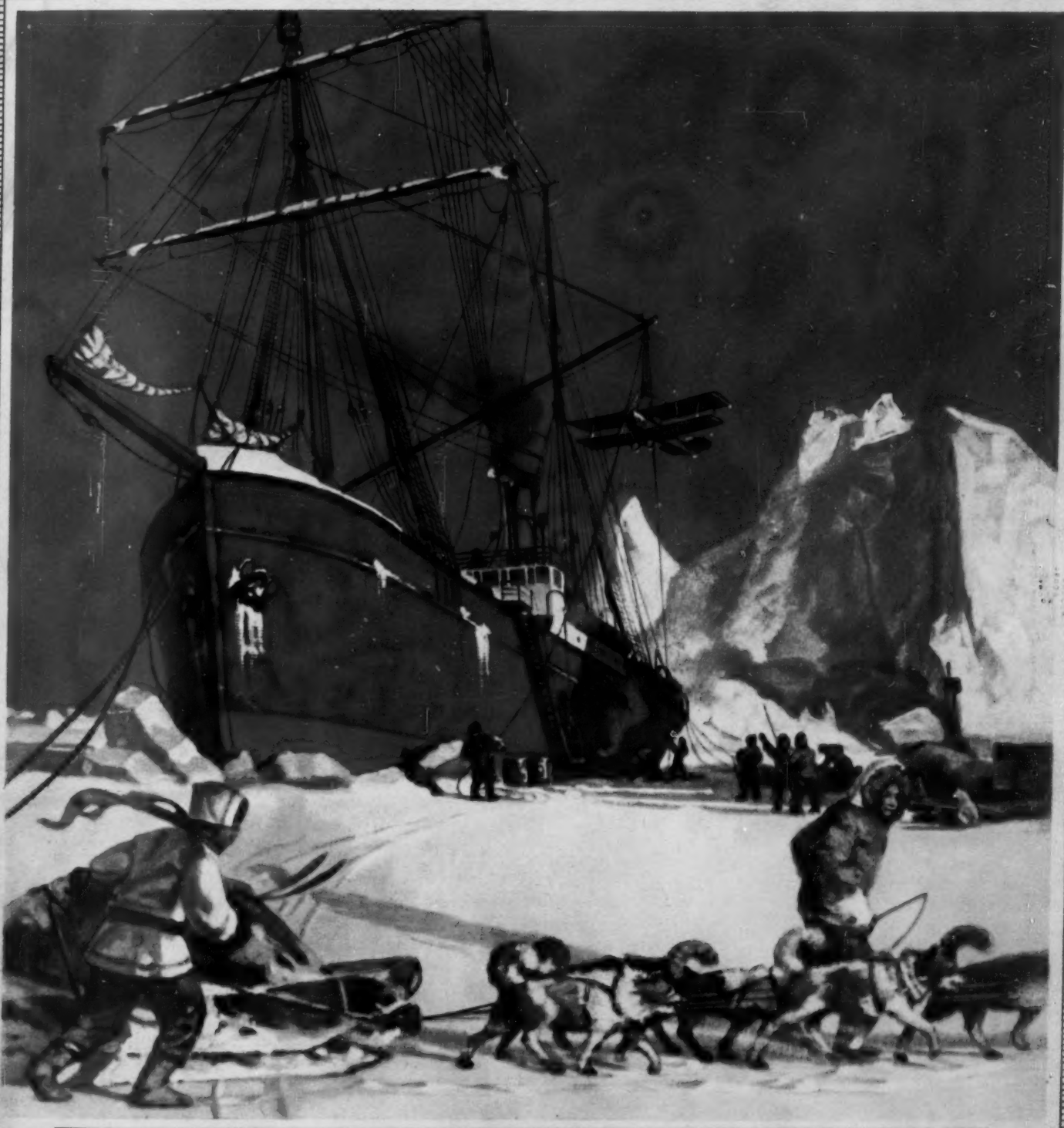
DEC 16 1921

SCIENTIFIC AMERICAN

The Monthly Journal of Practical Information

35¢ a Copy JANUARY 1922 $4.00 a Year



WITH AIRPLANE AND DOG SLED: SIR ERNEST SHACKLETON'S NEW ANTARCTIC EXPEDITION IN THE FAR SOUTH.—[See page 35]

Scientific American Publishing Co., Munn & Co., New York

Chart of Recommendations

(Abbreviated Edition)

How to Read the Chart:

THE correct grades of Gargoyle Mobiloils for engine lubrication of both passenger and commercial cars are specified in the Chart below.

A means Gargoyle Mobiloil "A"
B means Gargoyle Mobiloil "B"
E means Gargoyle Mobiloil "E"
Arc means Gargoyle Mobiloil Arctic

Where different grades are recommended for summer and winter use, the winter recommendations should be followed during the entire period when freezing temperatures may be experienced.

The recommendations for prominent makes of engines used in many cars are listed separately for convenience.

The Chart of Recommendations is compiled by the Vacuum Oil Company's Board of Automotive Engineers, and represents our professional advice on correct automobile lubrication.

NAMES OF AUTOMOBILES AND MOTOR TRUCKS	1921		1920		1919		1918		1917	
	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter
Allen	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Anderson	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Apperson (8 cyl.)	A	A	A	A	A	A	A	A	A	A
" All Other Models							A	A	Arc	Arc
Buick (Model 6, Junior)	A	Arc								
" All Other Models	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Briscoe	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Buick	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Cadillac	A	A	A	A	A	A	A	A	A	A
Chalmers	A	A	A	A	A	A	A	A	A	A
Chandler Six	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Chevrolet (5 cyl.)					A	A	A	A	A	A
" (Model 490)	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" All Other Models	A	Arc	A	Arc	A	Arc	A	Arc		
Cleveland	A	Arc	A	Arc						
Cole	A	A	A	A	A	A	A	A	A	A
Columbia (Detroit)	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Comet	Arc	Arc	Arc	Arc	Arc	Arc	A	Arc	A	Arc
" (Commercial)					A	Arc				
Cunningham	A	A	A	A	A	A	A	A	A	A
D-E (¾ ton)							A	Arc	A	Arc
" (2½ ton)	A	A	A	Arc	A	Arc	A	Arc	A	Arc
" (5 ton)	A	A	A	A	A	A	A	A		
" All Other Models	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Diamond T (1½ & 3 ton)	A	A	A	A	Arc	Arc	Arc	Arc	Arc	Arc
" Models U Dual & K Tractor	A	A	A	A						
" All Other Models			Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Dixie Flyer	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Dodge Brothers	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Dort	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Elgin	A	Arc	A	Arc			A	Arc	A	Arc
Essex	A	Arc	A	Arc	A	Arc				
Federal (Model S-X)							A	A	A	A
" (Special)							Arc	Arc		
" All Other Models	Arc	Arc	Arc	Arc	Arc	Arc	A	Arc	Arc	Arc
Ford	E	E	E	E	E	E	E	E	E	E
Franklin	A	A	A	A	A	A	A	A	A	A
Giant (using gasoline)	Arc	Arc	Arc	Arc	Arc	Arc				
" (using kerosene)			A	A	A	A				
Grant (6 cyl.)	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
" (Cam?) Model 12					A	Arc				
" All Other Models	Arc	Arc	Arc	Arc	Arc	Arc				
Hal-Fay	A	A	A	A	A	A				
H. C. S.	A	A	A	A						
Hassan (6 cyl.)	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
" (12 cyl.)	A	A	A	A	A	A	A	A	A	A
Hobart			B	A						
Hudson Super Six	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Hupmobile	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
I. H. C.							A	A	A	A
Jordan	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Jumbo	A	A	A	A	A	A	A	A		
Kelly-Springfield	A	A	A	A	A	A	A	A	A	A
Kissel (8 cyl.)	A	A	A	A						
" (6 cyl.)	Arc	Arc	Arc	Arc						
King (8 cyl.)			A	A	A	A	A	A	A	A
Kissel Kar (12 cyl.)							A	A	A	A
" All Other Models	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Lafayette (Indianapolis)	A	A	A	A						
Lexington (Continental Eng.)	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Liberty	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Lincoln	A	A								
Locomobile	A	E	A	E	A	E	A	E	E	E
Lozier (2½ ton)	A	Arc	A	Arc						
" All Other Models	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Marmon	A	A	A	A	A	A	A	A	A	A
Maxwell	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Mercer	A	A	A	A	A	A	A	A	A	A
Mitchell	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Monroe (Model M-3)							A	Arc	A	Arc
" All Other Models	A	A	A	A	A	A	A	A	A	A
Nash 6	Arc	Arc	A	Arc	A	Arc	A	Arc		
" (Cam?)							A	A		
Oldsmobile (Quad)	A	A	A	A	A	A	A	A		
" (Series 37 and 7 pass.)	A	Arc	A	Arc	A	Arc	A	Arc		
" (8 cyl.)	A	A	A	A	Arc	Arc	Arc	Arc	Arc	Arc
" (12 cyl.)					A	A	A	A	A	A
Oakland	A	A	A	A	A	A	A	A	Arc	Arc
Oldsmobile (4 cyl.)	A	Arc	A	Arc	A	Arc				
" (6 cyl.)	A	A	A	A	A	A	A	A	Arc	Arc
" (8 cyl.)	A	A	A	A	A	A	A	A	A	A
Overland	A	Arc	A	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Packard	A	A	A	A	A	A	A	A	A	A
Paige (6 cyl.)	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
" (Continental Eng.)	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" All Other Models	A	A	A	A			Arc	Arc		
Pan (Model 230)							Arc	Arc		
" All Other Models	A	Arc	A	Arc	A	Arc	A	Arc		
Peerless (6 cyl.)	A	A	A	A	A	A	A	A	A	A
" All Other Models							Arc	Arc	Arc	Arc
Pierce-Arrow	A	A	A	A	A	A	A	A	A	A
" (Cam?) (4 cyl.)	A	A	A	A	A	A	A	A	A	A
" All Other Models	A	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Premier	A	A	A	A	A	A	A	A	A	A
Ran	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Republic (1 and 1½ ton)	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" All Other Models	Arc	Arc	Arc	Arc	A	Arc	A	Arc	A	Arc
R & V Knight	B	A	B	A						
Saxon	A	Arc	A	Arc	E	E	E	E	E	E
Scripps-Booth (4 cyl.)							Arc	Arc	A	Arc
" All Other Models	A	A	A	A	A	A	A	A	A	A
Selden (½ ton)									A	Arc
" (1 ton)	A	A	A	A	Arc	Arc	Arc	Arc		
" All Other Models	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Stearns-Knight	B	A	B	A	B	A	B	A	A	A
Stephens	A	A	A	A	A	A	A	A	Arc	Arc
Studebaker	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Stutz	A	A	A	A	A	A	A	A	A	A
Templar	A	A	A	A	A	A	A	A		
Velie (Model 34)	A	Arc	A	Arc						
" (Commercial) (½ ton)					A	Arc	A	Arc		
" All Other Models	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc		
Westcott	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
White (16 valve)					A	A	A	A	A	A
" (3 and 5 ton)	A	A	A	A	A	A				
" All Other Models	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Willys-Knight	B	A	B	A	B	A	B	A	A	A
Willys Six					Arc	Arc	Arc	Arc	Arc	Arc
Winton	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc

Prominent Makes of Engines

Beaver (Models J-JA-JB and JC)	A	A	A	A	A	A	A	A		
" All Other Models	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Buda (Models ATU-BTU-CTU-DTU-ETU-FTU-HU-WTU-RTU-XU-XTU-YTU	A	A	A	A	A	A	A	A	A	A
Buda All Other Models	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Continental (Model R2)	A	A	A	A	A	A				
" (Model J)					A	Arc	A	Arc	A	Arc
" All Other Models	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Falls	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
G. E. & S. (Model AA)	A	A	A	A	A	A				
" All Other Models	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Lorraine-Dietrich (Models JU-6-V and VA)					A	A	A	A	A	A
" All Other Models	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Hinkley	A	A	A	A	A	A				
Lycoming	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Northway (Model 10R)									Arc	Arc
" All Other Models	A	A	A	A	A	A	A	A	A	A
Rochester (Duesenberg)	A	A	A	A						
Wisconsin (Models Q & QC)	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
" All Other Models	A	A	A	A	A	A	A	A	A	A

"GIVE ME A QUART OF OIL"

Blind Luck — or Science. Choose!

BY SAYING "Give me a quart of oil" you may accidentally get correct lubrication. But you are taking a long chance.

If you are one of the many who know the satisfaction of using Gargoyle Mobiloil we advise you to avoid this careless request.

Your best insurance of *engine results* is to ask for Gargoyle Mobiloil, being particular to specify the correct grade for your car.

The careless request, "Give me a quart of oil" means:

"Oh, I don't care who made the oil.

"I don't care how much carbon I get.

"I don't mind overheating, rapid depreciation, noise or repair bills."

You are matching blind luck against lubrication science.

Why correct lubrication is decidedly cheaper

During this very day, mechanics are busy repairing thousands of automobile engines. They are cleaning out carbon, fitting in new piston rings, putting in new bearings, regrinding worn cylinders.

At least 50% of these repairs were made necessary by bad lubrication—by the old haphazard—"Give me a quart of oil."

Not a gasoline by-product

Nine out of ten lubricating oils on the market are simply by-products in the manufacture of gasoline. Gargoyle Mobiloil is *not* a by-product.

It is produced by lubrication specialists who are recognized the world over as leaders in lubricating practice. Gargoyle Mobiloil is manufactured from crude oils chosen for their *lubricating* qualities—not for their gasoline content. They are manufactured by processes designed to bring out the highest *lubricating* value—not the greatest gallonage of gasoline.

This is one of the essential reasons for the superiority of Gargoyle Mobiloil.

GARGOYLE

Mobiloils

A grade for each type of motor

Domestic Branches: New York *(Main Office)*, Boston, Chicago, Philadelphia, Detroit, Pittsburgh, Indianapolis, Minneapolis, Buffalo, Des Moines, Dallas, Kansas City, Kans

VACUUM OIL COMPANY

With the Editors

WITH this issue, the third of the new monthly SCIENTIFIC AMERICAN, we are finding our stride, so to speak. It is no simple matter to change the habits of years: after having edited a weekly journal of popular appeal and a supplementary serious monthly review, we found it a little difficult, at first, to readjust ourselves to a single monthly journal combining the aims and ideals of both of our former publications. But what with the experience gained with each issue, together with the worthy suggestions of many of our friends and readers, we believe this new journal of ours is being rapidly molded into the kind of periodical that satisfies both the layman and the professional scientist. After all, it is your magazine, edited for you; and the editorial ear is ever listening for suggestions and criticisms that throw light on what you wish the SCIENTIFIC AMERICAN to be, in order that it will prove most indispensable at your desk, work bench, or in the library.

OUR editorial pages in this issue are devoted to a review of the past year. This double-page review has long been a feature of the SCIENTIFIC AMERICAN. In our former weekly the review of the year appeared in the first issue of the new year. We have always felt that this condensed résumé of the progress and achievements of the year just brought to a close served as nothing else would to check up on past performances for the benefit of the reader and ourselves alike. Why for ourselves? Just a word to clear this point. Living so close to the columns of the SCIENTIFIC AMERICAN, it is virtually impossible for the editors to develop a real perspective while any issue is still fresh in our minds. But—after an issue has been left six months or a year behind and its contents have been largely forgotten, the editors can critically read their own handiwork, being, for the time, in the position of the reader. For the moment we place ourselves on the other side of the publishing business; we review our own work from the reader's point of view; we learn with what degree of clarity we have described something which seemed quite simple to us who had seen it; we have an opportunity of criticizing our own efforts and improving our work. All of which is a good thing. Therefore, we welcome the review of the year.

OUR list of editors, contributing editors and so on, appearing on this page, reveals the presence on our staff of a goodly number of specialists. Apparently, however, it does not tell the whole story. Certainly it does not make it clear that one of us is rather absorbed in the study of old architecture; that another is a good deal of a motion picture authority—his hobby, in fact, is making motion picture films; that we have with us an enthusiastic collector of Dickensiana. Nor is this all. In casual conversation the other day it developed that one of the staff is a philatelist of parts, with an intimate knowledge of stamp markets, stamp frauds, and numerous other things of the sort. The conversation turned to counterfeits and counterfeiters, the sort of fakes that they try to foist off upon the collector, and the means employed to show these in their true character. It hadn't occurred to the philatelic member to suppose that anybody but a collector of old stamps would be interested; but his story made such a profound impression on the rest of the staff that he was at once called upon to tell it to our readers as well. This he has done. And he makes it plain that he has only begun to tell about the curious sidelights of his hobby, and that if you like the story he puts before you now, there is more material to draw upon.

ONE afternoon, not so very long ago, business in this office was just about suspended, while stenographers and editors, office boys and department heads gathered about one of the editorial rooms, from which the most amazing noises issued. Blood-curdling shrieks alternated with low moans and loud clankings; lions roared, dogs barked, shots were heard, and pandemonium in general had apparently broken loose. Initial suspicions that we were haunted broke down before the revelation that one of the editors had brought in a collection of noise-making properties that are used in connection with motion picture presentations. We gathered about the collection, appropriated the instrument with whose particular variety of racket we were most impressed, and proceeded to distribute the uprising somewhat. We are sorry we cannot print the sound waves and give some real idea of the delightful manner in which the artificial lion bellowed.

HAD Mr. Hughes' surprising attack upon the problem of naval establishments come a little earlier, it might have led us into omitting from this issue the statement by Mr. Bywater of Japan's program and her measure of accomplishment. But this part of the issue was on the press when Mr. Hughes made his address, so we could only hope that the progress of the conference would be such that we might be able to say an intelligent word of comment on this page—the last one to go to the printer. Another of those kaleidoscopic changes may completely shift the scenes; but we write these words at a moment when it seems fairly clear that most of the delegates have come to Washington prepared to be very enthusiastic about general disarmament.

WE started something. In one of the concluding issues of the weekly régime our automobiling member expressed some pointed opinions about the efforts made to light our highways for night traffice. It will be recalled that he summed up the situation by giving it as his experience that every style of highway lighting yet displayed was at best confusing, and often dangerous; that his own preference was all for the highway completely unlighted save by his headlights. This Phillipic brought a prompt visit from the genial gentleman who keeps us informed of what the big Schenectady research laboratories are doing—yes, we suppose he would have to answer to the title of Press Agent if anyone were to insist upon it. He told us that we had published this editorial right at the moment when the illuminating experts of his company had perfected what they considered to be the ultimate in highway illuminating. These folks, he reported, were all worked up about the matter, and were sure that if we would only come up and inspect the installation we would be convinced. We are willing to try anything once, so we went. And we were convinced. In the February issue we shall tell you all about it—what the new system is, how it works, and what it does. Right here, by way of indicating that the subject is of interest and importance, we will say that the road is lighted so that one can see a cat crossing it nearly half a mile away, and at a cost hardly in excess of that of the familiar ineffective lighting.

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SCIENTIFIC AMERICAN PUBLISHING COMPANY

Munn & Company, 233 Broadway, New York

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Vol. 126, No. 1. Published monthly. Entered as second class matter, June 18, 1879, at the post office at New York, N. Y., under the Act of March 3, 1879.

Price, 35 cents a copy. $4.00 a year. Postage prepaid in United States and possessions, and Mexico, Cuba and Panama; $4.50 a year for Canada. Foreign subscriptions, $5.00 a year, postage prepaid.

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TIMKEN Tapered ROLLER BEARINGS

Friction

Friction, from the beginning of time, has controlled man's progress, either as a friend or as an enemy.

Earliest evidence of the friendly use of friction was the rubbing of the hands and body to keep warm and finally the rubbing of a pointed stick to start a fire. But friction, like the fire which it starts, is, in many ways, man's formidable enemy.

In the operation of machinery and in the development of all automotive vehicles, friction must be held absolutely under man's control; or else, the mechanical power which has carried man from savagery to his present high estate, would be so wasted as to hold progress and development at a standstill.

Without anti-friction bearings (as they are called) machinery in general would have remained as in great-grandfather's day. No railroads would streak across the land—no motor cars—no trucks—not even power-driven boats could ply.

In this battle, against "enemy" friction, human inventive genius has progressed rapidly from the early cumbersome types of soft, slippery metal collars which encircled axles and shafts—through various applications of balls and rollers—to the tapered roller bearing of today, as typified in the product of the Timken Roller Bearing Company;—

It has progressed from those early nuisances that required greasing or oiling every few hours to the Timken Tapered Roller Bearing of today that requires attention as infrequently as every year or two.

Here we have a light, compact, and self-contained device that is friction's absolute master. For not only do Timken Tapered Roller Bearings hold friction to a negligible minimum—

But in so enabling wheels and shafts to revolve at frightful speeds with ease and safety—

Timken Tapered Roller Bearings, at the same time, carry all the loads that may be thrust upon them regardless of the direction from which these loads may come. No matter how, nor where, nor when that shock or load is applied—

Your Timken Tapered Roller Bearings rest snugly in their various housings, absorbing or deflecting those blows—

The while your motive power is being delivered through these bearings, without interruption, to the driving wheels.

And finally, when that wear which *must* follow all motion becomes apparent,—a simple adjustment and your Timkens function as when new.

THE TIMKEN ROLLER BEARING CO, CANTON, OHIO

Timken Tapered Roller Bearings for Passenger Cars, Trucks, Tractors, Trailers, Farm Implements, Machinery, and Industrial Appliances

SEND FOR TRUTH-TESTED FACT #2, "FRICTION"

SEVENTY-SEVENTH YEAR

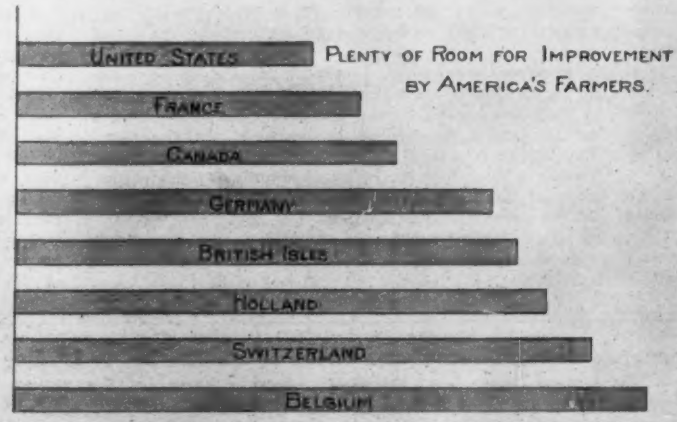
SCIENTIFIC AMERICAN

THE MONTHLY JOURNAL OF PRACTICAL INFORMATION

NEW YORK, JANUARY, 1922

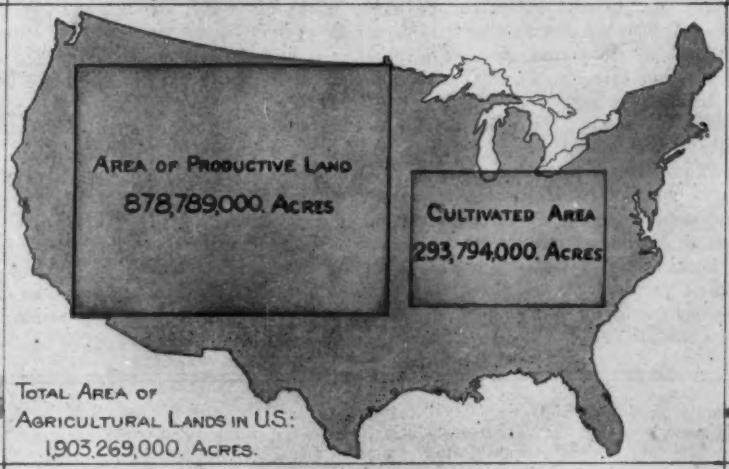
CORN CROP
1920

RELATIVE PRODUCTIVITY PER ACRE OF VARIOUS COUNTRIES
GAUGED BY AVERAGE YIELDS OF CEREALS AND POTATOES



POTATO CROP
1920

A YEAR'S STORY OF SUGAR



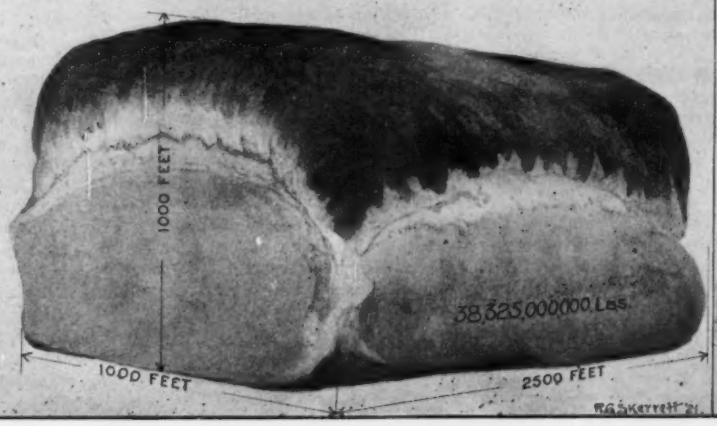
TOTAL AREA OF AGRICULTURAL LANDS IN U.S.:
1,903,269,000. ACRES.

MILK PRODUCED IN A YEAR

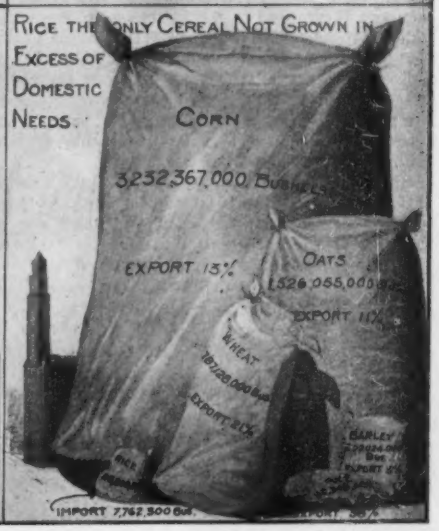
ANNUAL PRODUCTION OF DRESSED MEAT
FROM CATTLE, HOGS, AND SHEEP

CONSUMPTION 19,600,000,000. LBS.

THE LOAF WE EAT YEARLY
IT WOULD BE 27 PER CENT LARGER IF WE CONSUMED ALL OF THE DOMESTIC WHEAT



RICE THE ONLY CEREAL NOT GROWN IN EXCESS OF DOMESTIC NEEDS.



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OUR FOOD PRODUCTION AND CONSUMPTION AT A GLANCE: FACTS AND FIGURES ON OUR LEADING FOODSTUFFS, PRODUCTIVITY PER ACRE, AS COMPARED WITH OTHER NATIONS, AND RELATIVE AREAS OF PRODUCTIVE LAND AND CULTIVATED LAND. THE EIFFEL TOWER, WASHINGTON MONUMENT, AND WOOLWORTH BUILDING ARE EMPLOYED AS STANDARDS FOR COMPARISONS.—(See pages 6 and 7)

America's Domestic Food Supply

In Which We Take Inventory of Our Needs and How Far They Are Supplied by Home Production

By Robert G. Skerrett

HOW far is America's market basket filled from her own resources? Is the domestic food problem one that need cause us any alarm?

These questions are persistently recurrent, and are generally asked more frequently when the cold of winter grips the land and our arable acres cease, in large part, for the nonce to be actively productive. True, the sea, some inland waters, the range, and the barnyard continue to supply us with great quantities of foodstuffs year in and year out, but the main burden of sustenance rests upon the seasonal crops that are grown and harvested mostly during the prevalence of warm weather.

It is doubtful if the average citizen gives more than a momentary heed to the sources from which his daily diet is drawn; and taking the country by and large the public is generally ignorant of the immense amount of provisions that must be continually available in order that the physical wellbeing of the nation may be maintained at the proper standard. No matter how we may view the importance of our manifold industries, it is indubitably a fact that agriculture is the greatest of all of these activities. Indeed, it is the foundation of the nation's prosperity, for the very life and vigor of everyone is conditional upon plenty of good and nourishing food.

The biochemist has told us how many calories the food eaten daily by man, by woman, and by child should contain to meet bodily requirements under various circumstances of occupation; and this expert has taken pains to detail how the several percentages of nutritive elements can be obtained variously from divers edibles. Again, the more practical-minded student of the subject has explained that the average adult needs between 2½ and 4 pounds of foodstuffs every twenty-four hours to furnish a sufficiency of protein, fat, and carbohydrates. In passing, let it be recalled that the youth of both sexes demand quite as much at some periods to appease their appetites as do grownups. As a matter of fact our per capita consumption amounts daily to 4.1 pounds, and this calls for provender totalling 215,250 tons, or the annual providing and distributing of 78,596,250 tons of foodstuffs!

The American public spends $18,000,000,000 on its table each twelvemonth, or $49,315,000 per diem; and we are authoritatively informed that out of this stupendous sum 31 per cent is spent for bread, sugar, potatoes, and fruit, while 69 per cent is devoted to the purchase of meat, fish, eggs, milk, butter, cheese, and lard. The major part of these comestibles are produced by the 6,448,366 farms in the United States; and the area involved embraces an aggregate of 955,676,545 acres. The owning and the operating of these farm-lands represent a capital investment of $80,000,000,000; and the value of the annual output is in excess of $20,000,000,000.

Stupendous as these figures are, still they probably fail to bring home to most of us what they stand for in measures of foodstuffs. However, data are available which give the information desired and reveal at the same time how much it takes to nourish this nation and to have, besides, a surplus of some commodities for export. The work of our farmers during 1920—a year typical of large crops generally, resulted in an abundance of food for ourselves, great quantities of feed for our domestic animals, and a vast amount of raw materials for the fabrication of clothing. Our cultivated acres yielded 787,128,000 bushels of wheat; 3,232,367,000 bushels of corn; 1,526,055,000 bushels of oats; 202,024,000 bushels of barley; 69,318,000 bushels of rye; 13,789,000 bushels of buckwheat; and 53,710,000 bushels of rice, not to mention about 150,000,000 bushels of grain sorghums. In all, more than 6,000,000,000 bushels of cereals.

Further, our farms grew during the year mentioned a white-potato crop aggregating 430,458,000 bushels, while the sweet potatoes raised reached a total of 112,368,000 bushels. Of beans we had for distribution 9,075,000 bushels; of onions 19,119,500 bushels; and our markets handled 820,750 tons of cabbage. Beside these staple vegetables, the so-called truck crops furnished us with 577,464 tons of sweet corn; 24,683 tons of snap beans; 38,603 tons of asparagus; 41,654 tons of cucumbers; 12,106,055 crates of lettuce; 21,335,000 bushels of onions; 26,354,140 bushels of early white potatoes; 133,272 tons of peas; 2,422,000 crates of cauliflower; 1,022,258 tons of tomatoes; and 3,660,773 crates of celery.

From our orchards we obtained 43,697,000 bushels of peaches; 17,279,000 bushels of pears; 27,200,000 boxes of oranges; and 240,442,000 bushels of apples. The cranberry harvest netted 431,000 barrels; our melon patches yielded 11,652,356 crates of cantaloupes and watermelons to the number of 49,577,000, while our strawberry beds produced 4,590,700 crates. As all of us know there are other fruits and berries which play a more or less conspicuous part in our dietary, but space forbids detailed statistics.

With one exception, the people of the United States are the largest meat eaters in the world, and something like 22 per cent of their income is spent for this commodity. Therefore, in order to appreciate the magnitude of the industry devoted to gratifying this taste, let us see what our farmers and ranchmen produce to meet this demand. In 1920 our edible livestock was made up in the main of 23,321,000 milch cows; 42,870,000 other cattle; 45,067,000 sheep; and substantially 66,650,000 swine. During the year in question our abattoirs slaughtered more than 100,000,000 animals; and the dressed meat, including lard, amounted to quite 20,500,000,000 pounds. That is to say, there was placed on the market meat enough to supply everyone of us with 195 pounds, or about 8.5 pounds more per capita than the consumption.

For several years we have been eating less meat than previously and substituting larger quantities of other foodstuffs instead. That is to say, where our diet was formerly composed of about two-thirds meat and one-third cereals we are adding more of the latter to our fare and drinking larger measures of milk. The dieticians tell us that the change is better both for our bodies and for our purses. Striking a national average, each of us does away annually with 6.4 pounds of lamb and mutton, 80 pounds of beef and veal, and 100.1 pounds of pork. In this connection it is interesting to point out that the urban dweller consumes more beef and sheep products than his brother in the rural districts, while the latter eats more bountifully of pork.

Of marked economic importance is the prevailing tendency of the American public to eat more lamb per capita than is the case in any other country, while mutton is less and less called for by the people. This situation has been brought about by a realization that the sheep is quite as important as a source of meat as it is as a producer of wool; and the consumer prefers today the delicately flavored lamb to the stronger-tasting mutton. In the East, one pound of mutton and lamb is used for every five pounds of beef; in the South the ratio is one to ten; in the West it is one to twelve; and in the Central States it is one to twenty.

A quarter of a century ago there was virtually no difference between the market value, per hundred pounds, of a matured wether or a young lamb, and for that reason the sheep man held his stock a few years for the purpose of getting several clips of wool and then disposing of his old sheep at a fair price. However, a great many of these mature animals died of old age and never reached the market. Now, lamb commands not only a better price than mutton, and is more widely eaten here, but the augmented flocks furnish us with amplified stocks of wool. At the present time fully 75 per cent of the receipts at killing centers consists of lambs and yearlings and about 5 per cent of matured wethers—the remainder being old ewes and rams.

It has been said that the United States produces in the course of a twelvemonth enough poultry and eggs to buy the cotton and tobacco crops of the country for that period. Astonishing as this statement may seem, a little analysis reveals that it is correct. In 1920, the farm value of the tobacco grown was $318,359,000, and that of cotton reached $914,590,000—a total of $1,232,949,000. From our hen houses we garner annually now 2,500,000,000 dozen eggs, in round numbers, and our production of poultry during a like interval is in the neighborhood of 1,700,000,000 pounds. Taking the yearly mean prices for eggs and poultry, the farmers got in 1920 substantially $1,675,000,000 for these foodstuffs, bearing out the comparison quoted.

Coming down to dairy products, our citizenry are unusually favored. Despite the fact that our average cow gives in the course of a twelvemonth less than 4,000 pounds of milk, the total yield for 1920 was approximately 90,000,000,000 pounds or 10,400,000,000 gallons. From this we made 1,600,000,000 pounds of butter; 400,000,000 pounds of cheese; 1,578,000,000 pounds of condensed milk; more than 35,000,000 pounds of powdered, malted and sterilized milk, not to mention 260,000,000 gallons of ice cream, leaving then enough milk to enter into the manufacture of 370,000,000 pounds of oleomargarine and to provide fluid milk for household purposes to the measure of 43 gallons per capita annually. It is rather significant that our production of oleomargarine has increased more rapidly than our population. The per capita consumption of this foodstuff was only a little more than half a pound here in 1905, while at the present time it exceeds three and a half pounds.

From our waters, salt and fresh, we obtain yearly 2,400,000,000 pounds of fish, and about 72 per cent of this catch is taken from along the Atlantic seaboard. As a people we are not notable fish eaters—the yearly consumption per person being about 18 pounds as against 65 pounds in England. However, it is safe to say that nowhere else in the world can people remote from the sources of supply enjoy the variety and abundance of fresh seafood such as are available to our citizens hundreds, yes thousands, of miles inland. It may not be commonly known that 90 per cent of all of the fresh halibut eaten by us is caught off the coast of Alaska and delivered thence to all sections of the country. Similarly, most of the fresh salmon served us is moved long distances to gratify our palates. This matter of handling fish logically brings us to two prime phases of the question of our food supply—*i.e.* the modern methods employed to preserve perishable comestibles and to effect their distribution under circumstances that will insure their fitness for consumption.

The cold storage warehouse and the refrigerator car have revolutionized the American dietary and have made it practicable to spread the fruits of the seasons of plenty over the months of normal scarcity; to sta-

THE people of no other nation can boast a dietary as abundant and as varied as that of the dwellers in the United States; and the most suggestive aspect of this matter is that with few exceptions the vast bulk of these comestibles is of domestic production

Provided the farmer's labors can be made worth his while, our natural agricultural resources are such that we can take care of hundreds of millions of citizens more than we have within our gates at the present time. The problem is essentially a better and fuller use of the arable acres at our disposal. In this, science and engineering will play in the future larger parts than they have in the past.

To-day, the average American requires for the preparation of his three meals raw products totalling about four pounds; and, itemized, these are apportioned as follows:

Bread, 16 ounces; meat, 8 ounces; lard 1.42 ounces; milk, 16.3 ounces; vegetables, 12 ounces; fruit, 9 ounces; and sugar 4 ounces.

The distribution of these vital commodities among a population of 105,000,000, scattered throughout the length and breadth of the land, is a business of immense proportions which calls to its aid agencies of various sorts and of a highly developed character in certain instances. Without these facilities the bounty of one section of our land could not be placed at the disposal of another, nor could the overflow of one season be made available during the months of natural scarcity.—THE EDITOR.

bilize the agricultural industry over the entire year; and to neutralize climatic conditions so far as to enable the produce of warm or favored sections to be dispatched to those not so smiled upon by Nature. By reason of these facilities the American enjoys the year round a fuller, a better and a more diversified fare than his foreign fellow anywhere. Further, these same agencies encourage the utmost use of our arable acres through the assurance that a greater measure of their output will sooner or later reach a profitable market.

How, but for the cold storage warehouse and the refrigerator car, would it be feasible for us to put away during the spring and summer immense quantities of new-laid eggs, freshly made butter, poultry, fruits, and vegetables, etc., and then send them broadcast later on so that the mild months, in a food sense, can overlap or ameliorate the harsh conditions of the periods of cold? We are authoritatively told that eggs laid in April and placed promptly in cold storage are apt to be better than the rival fresh commodity that is sent direct from the nests to the market during August. Similarly, butter made from cream produced by cows feeding upon the succulent grass of the spring and early summer is sweeter and of finer flavor, even after months in cold storage, than butter churned later on in the year. The essential thing is that the perishable commodity, be that what it may, shall be in prime condition before it is put in storage, for this method of preservation can only arrest deterioration. Butter of an inferior quality will suffer more in storage than good butter; and the U. S. Department of Agriculture has held butter in cold storage for three years—the grade then being such as to warrant its scoring 92 out of a possible 100 in order of merit. However, for economic reasons, butter is usually less than a year old when it leaves the freezer for the market.

The length of time that eggs can be retained in a properly operated cold storage plant depends mainly on their state when they enter. Eggs laid during cool weather keep best and longest. Therefore, the March and April pack of eggs is held for midwinter use, while the June pack is usually disposed of during the late autumn and early winter, when seasonal production first begins to decrease. If the spring eggs have been carefully graded and packed before going into storage, they can be served poached or soft boiled and will be found palatable up to six months old, and they are still good for food at the end of nine months when prepared or used in other ways. At no time does the number of eggs in storage exceed 10 per cent of the annual production, while in the case of butter the quantity stored for subsequent distribution does not amount to more than 7 per cent.

Latterly, the frozen-egg industry has increased rapidly. Twelve years ago the eggs that are now frozen were practically a loss, because they either had cracked shells or were otherwise unfit for storage. The practice is to break these eggs into buckets or containers and then to freeze them. In this form they are sold extensively to bakers and confectioners; and thus an annual loss of $50,000,000 is avoided. The public is the gainer by reason of the greater quantities of cake, pies, and candy at its disposal, while there is a larger supply of perfect eggs for different purposes. For the sake of those unfamiliar with the subject, eggs in the shell are carried at a temperature low enough to preserve them but high enough to prevent freezing.

According to the requirements of the season and the market, foodstuffs are pre-cooled or frozen, and generally speaking the first process is applied to commodities that are to be held for a short while—ranging from days to a few weeks, whereas freezing is resorted to to insure keeping over a period of months. Fish in the frozen state have been so preserved experimentally for 27 months without showing any chemical change or material loss in palatability. Our annual frozen fish pack is, however, usually distributed within ten months.

According to the Federal authorities, we have 1387 cold storage establishments, representing an aggregate storage space of 463,025,213 cubic feet. Depending upon the nature of the business done by these concerns the temperatures range from 10 degrees below zero to 45 degrees above. In fact, the term cold storage, as legally defined, means the storage or keeping of any article of food at or below the temperature of 45 degrees above zero Fahrenheit. Some plants have at their disposal quite 5,000,000 cubic feet of space; and it seems that these conservation facilities do not at any time contain more than 10 per cent or 12 per cent of the meat supply of the nation. This indicates that they are used in a way that serves to stabilize both the agricultural and the fishing industries and that tends to steady prices against extreme variations.

Our citizenry as a whole, however, could not enjoy the bounty they now do if dependence were placed alone upon cold storage warehouses. The refrigerator car has become an indispensable link between these reservoirs of comestibles and our widely scattered consumers. Refrigerator cars—and there are thousands of them in use—widen the effective radius of cold-storage service, whether they be employed in the transportation of chilled or frozen commodities.

Other mediums by which seasonal abundance can be conserved for later consumption are our great grain elevators and our canning, drying, and preserving industries; and through these agencies a steadily increasing percentage of each crop reaches our tables from year to year. Both Federal and State authorities are doing their utmost to improve and to amplify our herds, our grains, our vegetables, our fruits, etc., and to develop those species and varieties which will flourish best in the different sections of the country suited to their propagation. Thus, in the main, the United States is able to load her market basket and to provide from domestic resources food enough for her people; but, even so, we do face a vital problem that sooner or later must be solved.

One hundred years ago out of all of the persons employed in American occupations 87.1 per cent were engaged in agriculture. A half century later the tillers of our soil represented only 47.5 per cent of our workers, and the U. S. Department of Agriculture, touching upon this point, has declared that it would not be surprised if the complete returns for 1920 showed that only 30 per cent of our industrial army are farmers. Whether this state of affairs will be offset by improved agricultural machinery, the wider use of the farm tractor, and greater reliance upon motor trucks for the speedy delivery of produce to shipping or distributing points, is a matter of speculation. Certain it is, in view of what is done abroad in some countries, that we can get larger yields per acre of several staple crops than we now do. This can be achieved by closer adherence to the scientific cultivation of the soil—putting into daily practice the lessons learned at our numerous Agricultural Experimental Stations. Nature has been generous to us, and America need never feel the pinch of want, never be short of food, if her husbandmen make the most of her available acres and diversified climate.

The Motor Tanker "Conde de Churruca"

A TWIN-SCREW oil tanker recently launched at the works of Sir W. G. Armstrong, Whitworth and Company, is described in *The Engineer*, Sept. 16, 1921. It is propelled by two 1250-brake-horsepower Armstrong-Sulzer engines, representing the most recent type of design and also being the largest engines of this type which have up to the present been fitted in a British mercantile vessel. The deck machinery, consisting of the anchor windlass, winches, and derricks, is all steam driven, the steam being raised in an oil-fired donkey boiler which also provides steam for the heating coils in the cargo and fuel tanks.

The engines develop each 1250 brake-horsepower at 100 revolutions per minute in four cylinders of 600-millimeter bore and 900-millimeter stroke. They are equipped with a rotary-sleeve valve which controls the admission of scavenging air to the cylinder. The correct position of this valve is determined for head and astern by a simple loose eccentric worked from the operating gear.

The starting and reversing mechanisms are so interlocked that no false start can be made. During the trials it was shown that each engine could be started and stopped twelve times consecutively without replenishing the starting receivers. There are eight of these, each of 800 liters capacity. In addition to the high-pressure receivers there is a low-pressure receiver supplied through a reducing valve. This receiver provides air service for the motors for the operating gear and the turning gear, and also for the air-driven lubricating-oil priming-pump and the whistle.

The piston is cooled by a spray, sea water being used as the cooling medium. During the war an experiment was made to test the effect of heat stress on the delicate parts of the engine. The test engine was overheated till the exhaust pipe was heated to redness and collapsed. When the engine was opened up the piston rings were intact and the lubrication was unimpaired, owing to the efficiency of the cooling system. The piston itself is made in two sections. The crown is only about 44 millimeters thick and is supported by five buttresses of special shape which allow the piston to take up its own position when the heat stresses come on. The piston-rod is so joined to the body that the piston is free to expand radially and sticking is claimed to have been entirely eliminated.

All control mechanism is grouped on the top platform in full sight of the valve-gear and fuel-pump mechanism. This is, however, optional, and the makers are also prepared to fit auxiliary control on the lower platform. The starting valve is operated by a mechanical device, so constructed that it can be readily removed and examined. This makes it possible for the engineer to assure himself that the maneuvering gear is in good working order. Among auxiliaries attention is called to the electric steering gear and the combined compressor and generator to be used for emergency purposes. This consists of a two-stage air compressor delivering air at 1200 pounds per square inch driven by a 12-horsepower hand-started hot-bulb engine, which is also coupled to an 8-kilowatt 110-volt emergency generator. The two engines, built with flywheels, pumps and all fittings, weigh about 330 tons.

The Electric Field of the Atmosphere During Storms

A SWEDISH physicist named Norinder has been engaged since 1918 at Upsala making careful measurements of the variations of the electric state of the atmosphere during the course of storms. For this purpose he records by means of a very rapid instrument the differences of potential manifested between two parallel horizontal wires, whose distance from the ground is adjustable up to forty meters in height. He thus determines through the oscillations which appear in the recorded curve, the variations of the "gradient" of the potential measured between the two wires; the term "gradient of the potential" is applied to the difference of potential between two points one meter apart from each other. The diagrams obtained make it possible to distinguish two kinds of variations in the electric field during a storm—first a slow variation lasting for at least ten seconds, which appears to be connected with the movements of the clouds and with silent discharges; next there appear very rapid changes in the electric field, which are connected with the flashes of lightning which occur in the vicinity of the post; in intervals of time much shorter than one second there may be observed the variations of the gradient comprised between 30,000 and 60,000 volts per meter. Several times gradients of 100,000 volts per meter were observed and on one occasion 135,000 volts per meter, and this in observations made at a distance of about 2 km. from the point where the electrical discharge was produced.

The most interesting thing about these measurements is the proof they furnish that the value of the electric field of the atmosphere during storms has hitherto been underestimated. It has been thought heretofore that the maximum gradient in the vicinity of the ground was only about 20,000 volts per meter. Norinder's experiments prove it may be much greater, and this explains many accidents on electric lines which had been thought to be sufficiently insulated. Since Norinder's observations made at several kilometers distance from the electric discharge itself show gradients as high as 100,000 volts per meter the gradient in the actual neighborhood of a "thunder-bolt" may be really formidable.

Gear-Shift Innovations

ONE remarkable solution of the change-gear problem is the *Lentz Hydraulic Gear* exhibited by the constructors, Messrs. Bruschke & Bergner, of Berlin. This comprises a system of oil pumps, the primary part of which is driven immediately from the motor and, according to the actual adjustment, feeds one or several secondary pumps with compressed oil. There are no toothed wheels, the mechanism works quite smoothly and noiselessly and the wear and tear on the motor and tires is reduced to a minimum. The gear also serves as a hydraulic brake and does away with any clutch, one special type being at the same time a substitute for the differential gear otherwise indispensable.

A radical solution of the change-gear problem has been devised by Dr. Maybach, by doing away entirely with this organ. In fact, Messrs. Maybach-Motorenbau, Ltd., of Friedrichshafen, have on show a *gearless motor-car*. Instead of transmitting the energy of the remarkably elastic motor to the rear wheels through the intermediary of a four-speed change-gear, the jointed shaft leads immediately from the clutch to the rear-axle drive. The motor is started electrically, the starting pedal being so arranged beside the accelerator as to enable both to be acted upon simultaneously until the carburetor position most favorable for starting is reached. The starting motor is so designed as to start safely and noiselessly not only the motor, but the whole of the car. In addition to the usual braking pedal, to the right of the steering column, there is provided, in the place of the ordinary clutch pedal, a pedal actuated whenever an extraordinarily heavy gradient is to be negotiated. When pushing this "Mountain Pedal," there is readily noted an intermediary position where the motor is out of connection with the driving gear and therefore can be kept running light, whenever this, for some reason or other, is thought desirable.

The Radio Central

America's Bid for World-Wide Wireless Supremacy as Crystallized in the Huge Station at Rocky Point

By Austin C. Lescarboura

COMMERCE and rapid communication are partners. Especially is this true in long-distance commerce, which only became possible with the establishing of a universal postal service, and really practical with the development of still more rapid means of communication in the form of the telegraph, cable, and wireless. Today the merchant in New York deals with his customer in China with every possible facility; for a rapid and reliable interchange of thoughts brings these parties within what veritably amounts to speaking distance. The more detailed matters are handled by correspondence, to be sure; but there is urgent need for the faster arteries of communication now available even to the remotest corners of the earth.

Until now we Americans have been pretty well satisfied to do business among ourselves, with little thought and attention paid to the outside world. Such export trade as we did handle was largely unsolicited. But now that the world has turned a new corner and we find ourselves obliged to take a hand in international trade, there is little doubt but that we plan to play this game just as strenuously and thoroughly as anything else in which we have yet engaged.

The first step is to establish rapid and reliable means of communication with the leading countries of the world. Not satisfied with the vast network of cables, we are going ahead with a vast system of wireless which will place us in direct touch with our friends in Europe and our neighbors to the south. Our plans, which are well along toward realization, are to make New York City the focal point of wireless or radio traffic, just as Great Britain has long been the center of a large network of cables.

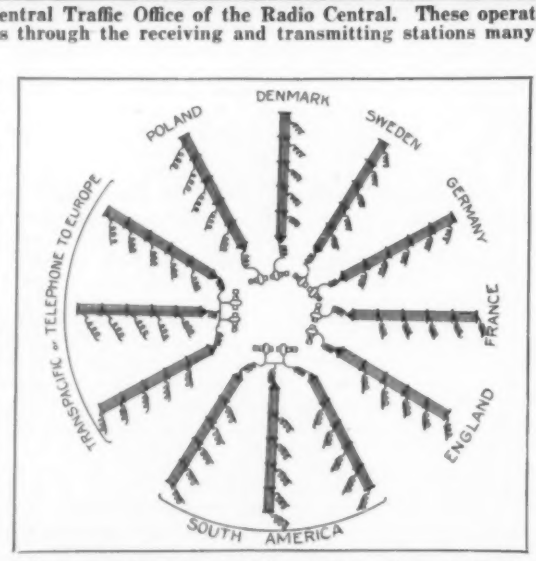
These plans find expression in the huge Radio Central which is now in operation to the extent of one-sixth of its ultimate capacity. With the foregoing facts as a background on which to estimate the value of this gigantic enterprise and the pressing need for its services, a description of this largest and latest of wireless stations is of more than passing interest.

Radio Central is, as its name implies, a group of wireless stations that have been centralized for the purpose of more ready handling. Radio Central is located at Rocky Point, Long Island, about seventy miles east of New York City. Yet the actual operation of this station takes place in an office on Broad Street, in the very heart of New York's financial district. It is quite likely that the operators who send and receive the dispatches through Radio Central may never see the transmitters with which they work over a direct land line, while the attendants at Rocky Point may understand little and care less of the dots and dashes flashed out by their equipment.

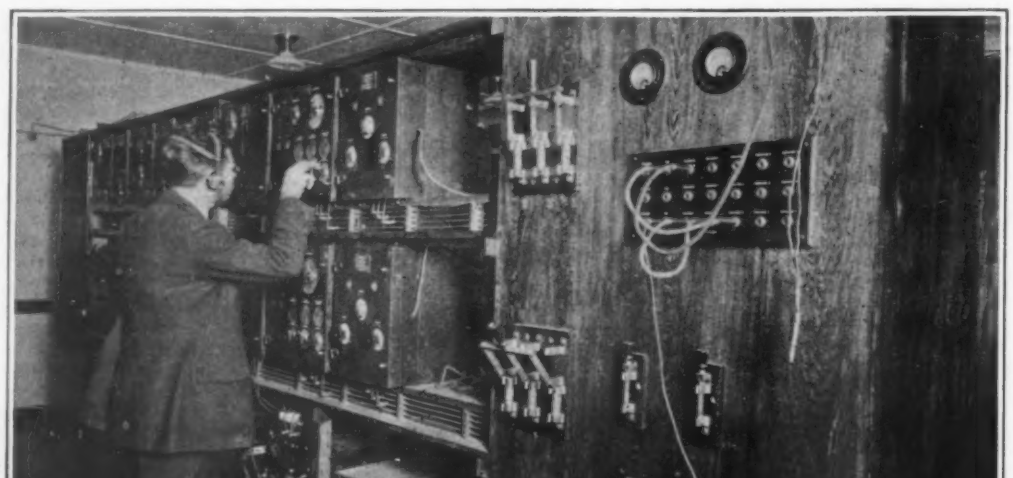
A description of Radio Central appeared in these columns at the time it was first conceived. That was about a year and a half ago. The plans call for twelve aerials, arranged as the spokes of a wheel radiating from a center in which is located the transmitting station proper. Each spoke of the wheel or single aerial comprises six steel towers, so that there are seventy-two steel towers in all. Each spoke is 1½ miles long, or three miles for the diameter of the wheel or circle circumscribing the towers and the aerials. The station site covers 6400 acres, or about ten square miles.

At the present writing the first twelve towers have been erected and the two aerials which they support are in operation. The construction of Radio Central began July, 1920, and the first test signals were sent in October, 1921, or a little more than a year from the time work was started. On November 5th the first unit of Radio Central was officially thrown open to the public with elaborate ceremonies, the principal feature of which was the broadcasting of a message by President Harding. The President, pressing a button in the White House, set to work an automatic transmitter which sent his message over land line to Rocky Point, where it was automatically relayed to the Alexanderson high-frequency alternator and dispatched to the most distant points in the form of radio waves.

General view of the Central Traffic Office of the Radio Central. These operators receive and transmit radiograms through the receiving and transmitting stations many miles away



Diagrammatic layout of the aerial system of Radio Central, indicating the separate aerials, towers, helix units and alternators



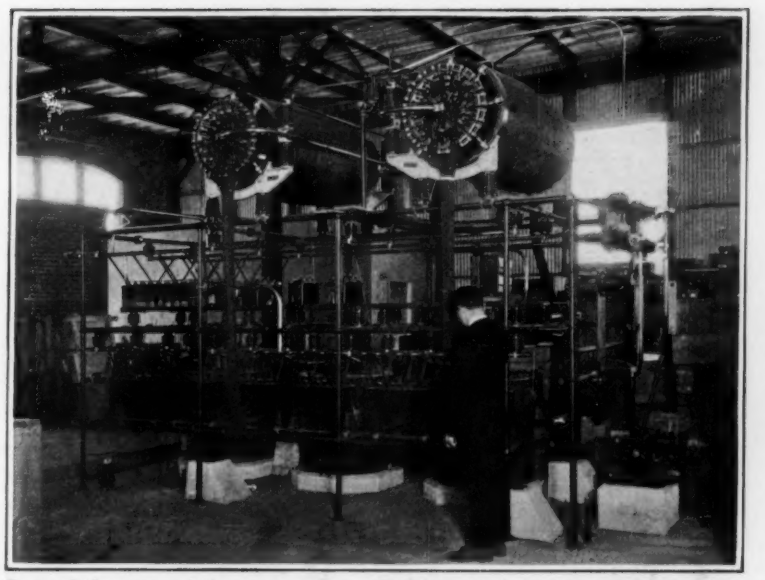
Arrangement of the receiving apparatus at the Riverhead station. Note how the various units for tuning, detecting, and amplifying are arranged. The engineer is shown adjusting a receiving unit for the receiving operator in New York City

Each steel tower of Radio Central is 410 feet high, while the cross-arm or bridge supporting the aerial wires at the top measures 150 feet from tip to tip. In all, 1800 tons of structural steel were used to erect the first twelve towers, each tower requiring approximately 150 tons. Furthermore, 8200 tons of concrete was employed for the foundations of the twelve towers, the base of each tower leg being sunk nine feet below the surface of the ground. The distance between two adjacent towers is 1250 feet. Curiously enough, one fails to be convinced of the magnitude of these towers, for the good and sufficient reason that they stand more or less alone in a wilderness of shrub oaks and small bushes, so that there is no ready means of drawing a comparison as to size. In fact, many visitors to the station on the opening day stepped from the special train with the firm belief that the station was but a short distance away. The steel towers appeared to be a quarter of a mile away, perhaps a little farther, but certainly within easy walking distance. Yet to their keen disappointment these same visitors who had set out on foot discovered that Radio Central was several miles distant, and that the towers are highly deceptive both in size and in intervening distance. They may be seen for many miles across the slightly rolling country of that part of Long Island.

Each aerial consists of sixteen silicon bronze cables three-eighths inch in diameter, stretched horizontally from tower to tower. In all, fifty miles of this cable has been used for the two aerial systems already completed. On the other hand, the ground system for both aerials consists of 450 miles of copper wire buried in the ground under the entire aerial system in starfish and gridiron pattern. At regular intervals the aerial is connected to the ground through a huge outdoor helix in accordance with the multiple-tuned aerial practice developed by the Radio Corporation of American engineers. Each of these helix or inductance units is several times larger than a man and altogether add greatly to the complexity of the Radio Central installation.

So much for the aerial system, which forms such an important part of any radio station. The first power-house section which, as already stated, is located in the center of the aerial system, covers a space of 120 feet by 60 feet and accommodates two 200-kilowatt Alexanderson high-frequency transmitting alternators with auxiliaries and equipment. It is a far cry from

the old crashing spark gap of earlier transatlantic stations to the quiet and businesslike Alexanderson alternator. Yet this machine, which differs very little from the usual light and power generator so far as externals go, has brought about a new era in commercial radio. In place of the spectacular it has wrought the practical; in place of the uncertain, troublesome and awkward spark transmitter it has introduced the almost silent, simple and convenient high-frequency generator which produces current that requires few auxiliary pieces of equipment before sending it to the aerial, there to be propagated in all directions in the form of radio waves. The Alexanderson alternator also makes radio telephony a more practical thing than had been hoped for but a short while back, although it seems likely that ultimately all transmission, whether on a small or large scale, will be handled by vacuum tubes. Much remains to be done in the way of perfecting large vacuum tube units and reducing their first and upkeep costs, but the vacuum tube is obviously the ultimate radio transmitter, eliminating as it does all moving parts and elaborate accessories. However, that is another story.



Part of the transmitting apparatus at Radio Central, neatly mounted on iron framework for ready inspection and adjustment. The magnetic amplifiers are placed on the floor, and the inductance units above

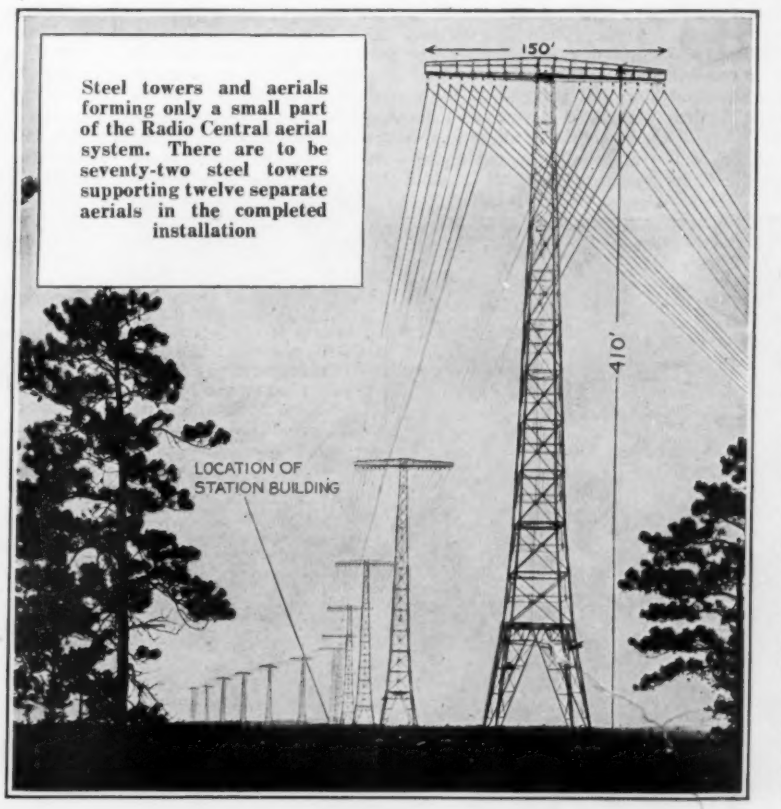
Now let us get this operating scheme of Radio Central clearly established. First of all, each aerial amounts to a separate transmitter—a separate station, practically, serving as the artery of radio communication with a single overseas station. Thus one aerial or "leg" will serve as the transmitter to France, another to Great Britain, another to Germany, still another to Scandinavia, and yet another to Poland. South American countries will be taken care of by other aerials of the twelve that will ultimately complete the Radio Central. Each aerial is served by a single 200-kilowatt Alexanderson alternator, although it may be that for extreme distances, such as South American and transpacific services, two or three aerials may be used as a single transmitting unit, energized by two or more alternators.

Radio Central is divided into a transmitting station and a receiving station. Only the transmitting station has thus far been dealt with. The receiving station is located at Riverhead, Long Island, some sixteen miles away from the transmitting station at Rocky Point. As in the case of Rocky Point, no operators are located at Riverhead, because the distant signals are intercepted by the radio equipment and automatically transferred to wire lines and received as audible signals at the Central Traffic Office in New York City. The action is practically simultaneous from the moment signals are transmitted from the overseas station and picked up at Riverhead, to the moment of actual transcribing by the receiving operators in New York.

The centralized control as accomplished by the Radio Corporation's transmitting station at Radio Central and receiving station at Riverhead, as well as its other high power stations, has solved the problem of multiplex operation and made possible this practical communication service which is now at the disposal of the American business man. A sending speed of 100 words per minute is at present possible with the use of each transmitting unit at Radio Central. This means a combined sending capacity of 200 words per minute for the two completed units. The transmission range of Radio Central is practically world-wide, as demonstrated by preliminary tests when the station was heard in all parts of Europe, as well as in such far-flung corners as Australia, South America and Japan.

Following the universal practice of making modern long-distance wireless stations as attractive as possible, Radio Central has received various little touches here and there which have more to do with human engineering, so to speak, than radio engineering. We have in mind the attractive Community House for the staff at the transmitting station. This is a low one-story building which bears strong resemblance to the usual country club. It contains sixteen single rooms for the unmarried members of the staff, an official suite, a large living-room and dining-room, as well as quarters for the help. Then there are several detached bungalows for the married members of the staff. The personnel necessary to maintain the huge station in operation comprises the engineer in charge with a staff of fifteen assistants, for the present. Ultimately, as one by one the transmitting units are added to the Radio Central, more personnel will be required, it goes without saying. Another little touch which sets off the station and softens its otherwise grim aspect is the cooling pond, for cooling the water after it has circulated through the high-speed alternators. This basin of water covers a ground space of 64 by 42 feet, and is 7 feet deep. The pond is equipped with four spray heads which, when operating, present a beautiful and ornamental appearance, dressing in no little measure the entrance to the transmitting station building.

Radio Central must mean the focusing of the radio systems of the world on New York City. When completed its capacity and its range will be such as to bring the leading nations of the world to the very door of the American metropolis, to and from which auxiliary communication can be maintained over the usual telegraph and telephone lines, in order that the entire country may use Radio Central. When completely realized, Radio Central will probably comprise ten high-frequency alternators, giving a total output of 2000 kilowatts, or 2700 horsepower. A mighty big bid for the world's radio supremacy, is it not?



Steel towers and aerials forming only a small part of the Radio Central aerial system. There are to be seventy-two steel towers supporting twelve separate aerials in the completed installation

Theodore G. Hoster

IT is with great regret that we are obliged to chronicle the death of Mr. Theodore G. Hoster, who was associated with Messrs. Munn & Co. as a patent attorney for over forty years. In this connection he was known to thousands of clients who had occasion to consult him in relation to patent cases. Mr. Hoster was one of the best recognized experts in the United States on several lines of invention activity, and his disinterested advice was always at the service of all. Although Mr. Hoster was not a native of the United States, having been born in Germany in 1854, no one was more thoroughly Americanized than he. He was educated at a technical school in Winnweiler and came to this country in 1871.

His first activities were related to mechanical enterprises in Ohio, Florida and Mississippi, and he was at one time identified with steam navigation on the Mississippi River. He finally gravitated to New York, and in 1880 he became one of the patent attorneys of Messrs. Munn & Co., and for over forty years gave up his life to the prosecution of patent cases.

He numbered among his clients some of the most successful inventors which the United States has ever produced. Commissioner Moore stated that Mr. Hoster had prosecuted more applications before the Patent Office than any attorney he ever knew of. There is little question that Commissioner Moore is right in this statement, and thousands of his clients will be very sorry to hear of his death. His associates in the patent offices of Messrs. Munn & Co., and also the SCIENTIFIC AMERICAN, mourn his loss very deeply, as Mr. Hoster was a man of sterling integrity and his friends were friends of a lifetime.

Design of Atmospheric Burners

THE Bureau of Standards has carried on an extensive investigation of gas burner design intended primarily for the benefit of manufacturers of gas appliances and industrial gas appliance engineeers.

The results of this work are given in Technologic Paper No. 193 of the Bureau of Standards which is now for sale by the Superintendent of Documents, Government Printing Office, Washington, D. C.

In this paper no extensive presentation of the theory has been attempted; the aim being rather to show by means of tables and curves based on experimental data the effect of various factors on the operation of burners. With the arrangement of apparatus and method of testing that has been developed, it is possible to measure quickly and accurately the volume of air injected into any burner under any condition of operation, as well as to determine the limits of operation with any quality of gas. Such information is essential in order to enable one to design burners for any predetermined condition of operation. In order to understand the various factors entering into the design of burners, it was found necessary to study the theory of the flow of gas through different types of orifices, the principles governing the rate of injection of air into the burner, the design of the injecting tube, the rate of consumption of burners of different port areas, and the effect of adjustment of the air shutter. These various factors are taken up in detail.

In conclusion it is pointed out that on account of its simplicity, low cost, and reliability, the atmospheric gas burner is well adapted for domestic and most of the smaller industrial purposes. If it is possible to widen the range within which such burners can be operated efficiently and without adjustment, and design them to meet the needs of any particular purpose, it will make gas fuel much more valuable and will broaden its field of application.

With these facts in view the Bureau has been conducting experiments on atmospheric burners both with natural and artificial gas and the results will be reported in subsequent papers.

The Hydraulic Laboratory

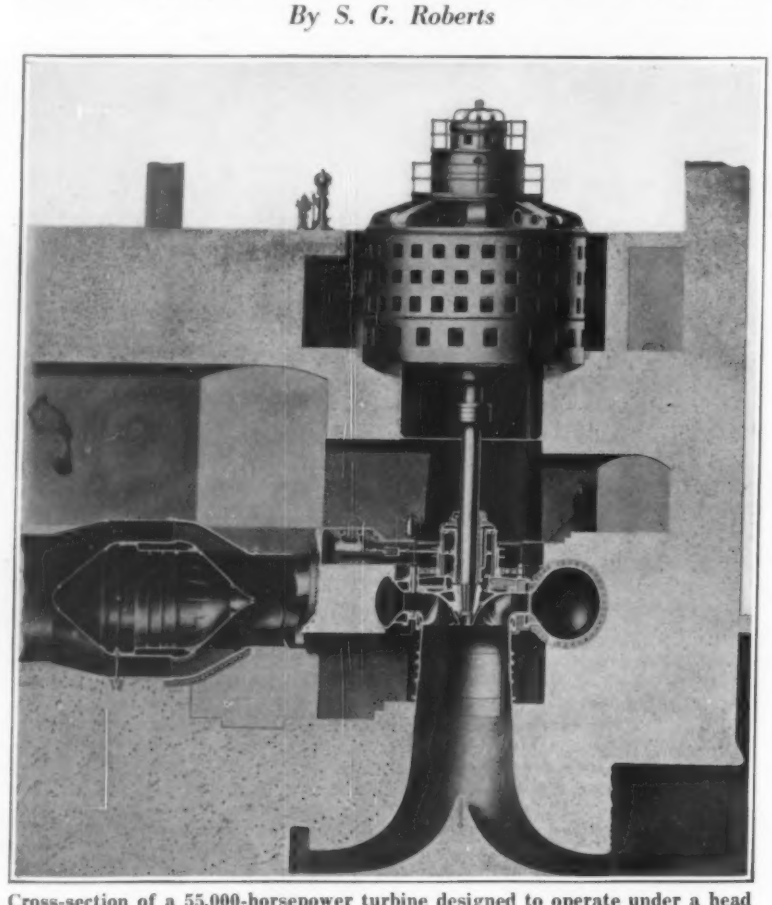
A Prime Aid in Helping Us to Make the Most of Our Waterpower Resources

By S. G. Roberts

WE have actually in service today a total of 8,200,000 horsepower which is developed by the impulse of falling waters. In the near future a number of hydroelectric projects will be taken in hand which will amplify this block of energy by approximately 2,000,000 horsepower; and to accomplish this will call for the expenditure of substantially $2,000,000,000. We are at last awake to the fact that fuel is costly and the price disturbingly variable, while Nature's running waters can be made reasonably uniform in their flow, are inexhaustible, and are free—the same volume being available for successive users provided the head remains high enough.

The public at large has an imperfect conception of the evolution that has been taking place since we began the building of hydroelectric power stations. The modern water turbine is a radically different apparatus from the water-wheel which for a long time served to furnish motive energy. Thanks to the cunning coordination of practice and theory much has been done in the direction of betterment, and performances now are vastly superior to those but two decades back in this particular realm of mechanics.

As recently as 1900, the efficiency of standard types of water turbines did not exceed 78 per cent when operating at 100 per cent of their rated power, and at half load their efficiency dropped to something like 48 per cent. Today, there are turbines at work that have an efficiency ranging from 90 to 93 per cent when turning over at speeds capable of producing anywhere from 50 to 100 per cent of their rated power. That is to say, the units are able to perform admirably when carrying only a part of their maximum designed loads. This is a matter of importance in meeting changing demands for electrical energy.



Cross-section of a 55,000-horsepower turbine designed to operate under a head of 305 feet and to run at a speed of 187.5 revolutions per minute. The generator surmounts the driving shaft. At the lower left is seen a penstock valve in position. Beneath the turbine is the recently developed spreading draft tube which exhausts into the tailrace at the extreme right

No small share of this advance in the art is due to the aid of the research laboratory where the diversified problems of the water turbine have been studied under conditions which have clarified many puzzling questions and revealed phenomena that were undreamed of or only suspected. This line of investigation has expanded from year to year; and in pace with it have been provided equipment and facilities which render it feasible to duplicate on a small but suitable scale the essential features of a complete and big commercial hydroelectric installation.

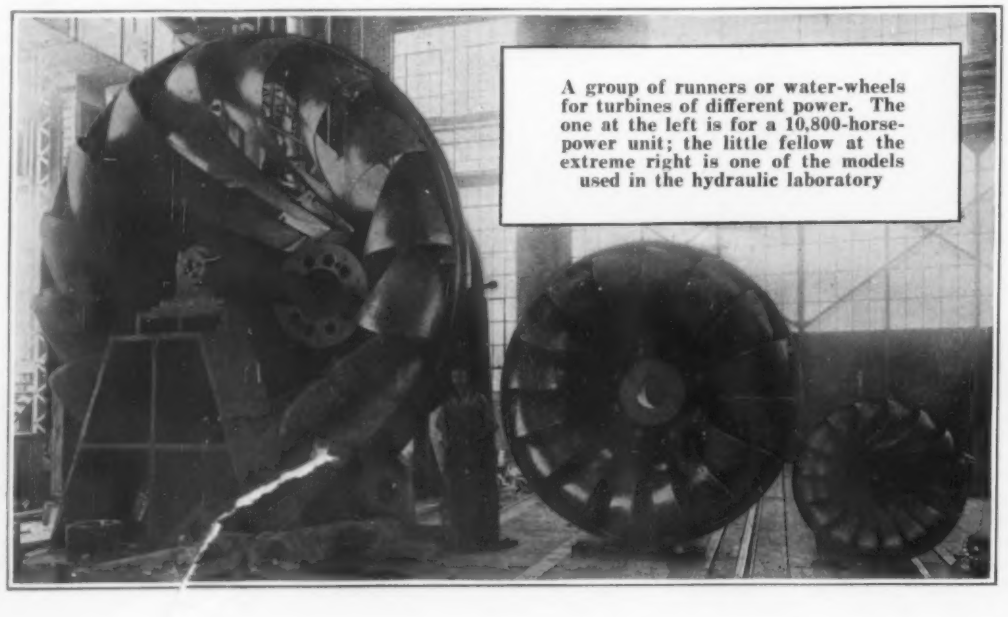
Much experimenting has been done by power companies and turbine manufacturers at the Holyoke Testing Flume, Holyoke, Massachusetts, and runners have been tried out there on a steadily increasing scale. The results, while often extremely good, were not subsequently reproduced so satisfactorily when the turbines as a whole were placed in their ultimate positions. This fact, and the additional consideration that the "waiting list" at the Holyoke Flume was generally a long one, led one of the participants in the Holyoke project to branch out, and establish its own hydraulic laboratory at Petty's Island in the Delaware River. The plant has amply compensated for the outlay, and has been instrumental in unraveling some questions and in bringing about certain notable improvements in water turbines and their associate features.

The laboratory at Petty's Island has obviated the inconvenience of shipping to Holyoke the equipment required for numerous separate tests, and it has enabled the Philadelphia firm to carry out its research on complete turbines, including the turbine runner and draft tube passages leading therefrom. This has latterly been found to be of vital importance. It has for sometime been realized by hydraulic engineers that the greatest development in water turbines is likely to lie in increased specific speed of the runners or wheels, as they are popularly termed. That is to say, where a given amount of power may be generated under a fixed head of water, future success will hinge upon the ability to obtain this power by employing single-runner, direct-connected turbines making the highest possible number of revolutions per minute. Machines of this character cost less to build, permit the use of cheaper generators, and render it feasible to utilize low-head sites. These were the desiderata that induced the Philadelphia company to erect its hydraulic laboratory.

To the popular mind the impulsive force of water driving a hydraulic turbine entails nothing more complex than directing the flowing water to the wheel blades and then providing a passage by which it can escape into the tailrace and thence into a nearby stream. As a matter of fact the efficient utilization of the water's pent-up energy or momentum is nothing like so simple; and the function of the hydraulic laboratory is to enable the technicist to analyze and to evaluate the divers variables in advance of constructing the power units of hydroelectric stations.

The day was not so long ago when the turbine manufacturer had "stock" or so-called "standard" designs which he was ready to turn out on demand for any power site, and, needless to remark, some of these performed fairly well while others were decidedly indifferent in their efficiencies. The hydraulic engineer now knows that every change of head and numerous other physical circumstances exert more or less marked influences upon the characteristics of the machine which can be counted upon to function to the best advantage. In the western sections of the United States or wherever the precipitous drop of the waterway affords a high head, turbines of lower specific speed are more suitable; while in the eastern portion of the country low heads predominate, and for these turbines must be differently modeled so that they will run at higher specific speeds. In each case the components of the installation have to be altered to harmonize with the circumstances imposed by Nature and the physical laws that prevail.

To satisfy these conditions, and to live up to the guarantees which manufacturers have to make to power companies, the builders of turbines can no longer depend upon rule-of-thumb methods—they must be sure of their products; and to encourage them in this purchasers not infrequently offer tempting bonuses for every bit of increased efficiency over that called for by contract. It is no unusual thing for a premium of a thousand dollars to be paid for each per cent over and above the efficiency stipulated in the agreement; and when this applies to the several turbines in a large installation the reward is well worth every reasonable effort to win. Success soon justifies the outlay for the laboratory and the model tests.



A group of runners or water-wheels for turbines of different power. The one at the left is for a 10,800-horsepower unit; the little fellow at the extreme right is one of the models used in the hydraulic laboratory

The research work at Petty's Island, Pennsylvania, has enabled the operating company to fabricate turbine runners having an increased specific speed of about 100 per cent. In other words, painstaking investigation has enabled that firm in certain instances to offer quotations on turbines so patterned that they would run at twice the speed previously deemed practicable—thus bringing about marked initial and operative economics. It seems that high speed is a more important factor than high power in cutting down first cost, because high speed permits a reduction in the size of the turbine and the electric generator and ren-

ders it feasible to simplify the design of the turbine, especially when it is to be placed in low-head installations. Let us make this plain.

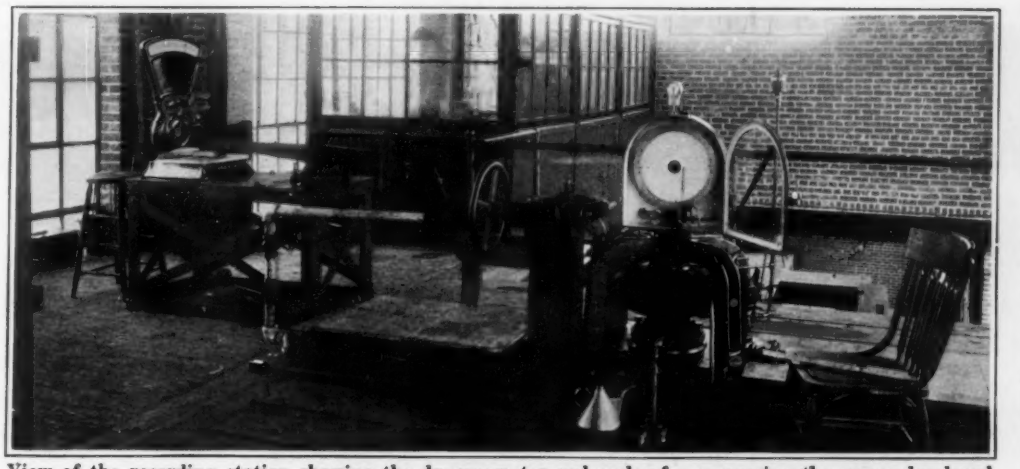
A few years back, in order to obtain reasonable generator speeds which would give the best electrical effects with a given type of dynamo, it was at times necessary to resort to multi-runner turbines — machines having as many as six runners or water-wheels on a single shaft. This called for six sets of guide vanes, interconnected operating gear, four or more bearings, and a corresponding increase in other associate features. Apart from adding greatly to the original cost and operating expense, the multiplicity of parts invited more risk of breakdown. With the development of the high-speed runner many of these complications have been avoided, and a single water-wheel, combined with vertical shaft units of relatively few parts, and these simple and rugged in getup, can now be constructed for less money and yet perform far better than their predecessors.

A concrete example of the gains derived by this advance in the art will help us to appreciate the aid rendered by the hydraulic laboratory. A certain power company in Pennsylvania equipped a plant in 1910 with five units of the two-runner, vertical-shaft type. Four years later, when more power was desired, it was decided to adopt a single-runner, high-speed design. The new apparatus was secured at a considerable saving in first cost; and tests made after the installation showed a maximum efficiency of 93 per cent for the modern unit as compared with 83 per cent for the older two-runner turbines.

The man in the street may not grasp off-hand just how essential it is for a turbine to be notably efficient. He understands, of course, that careful utilization of coal in a steam power plant is extremely desirable, for that fuel must be bought and handled. To him, on the other hand, water is in a sense free and, therefore, why bother about the measure used in developing the prescribed horsepower? The answer is: Where international streams, for instance, are concerned and treaties set the exact amount of water which can be diverted from these rivers for industrial purposes, it is a matter of moment that the permissible volume shall be made to yield the largest practicable percentage of motive energy. Similarly, where water for hydro-electric stations is purchased from irrigation projects or where its use is in any way restricted there is sure to be a proportionate gain through the adoption of turbines of marked efficiency.

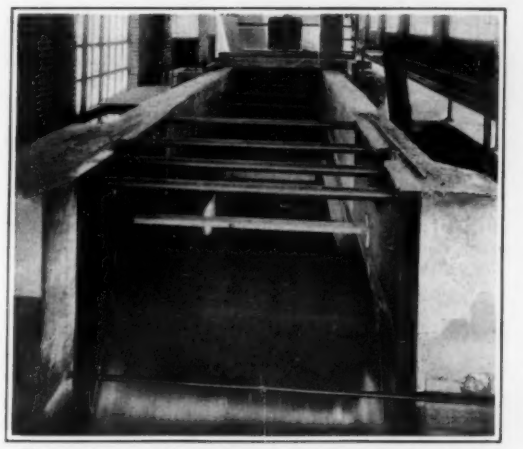
The hydraulic laboratory is proving a valuable aid in the evolution of water turbines of conspicuous reliability. While it is true that this factor should characterize any type of machinery still it is especially to be desired in hydroelectric plants—particularly if these be large. A shut-down for inspection or repairs involves a loss in power output which cannot be offset by any "saving in the coal pile." On the other hand there is a direct sacrifice in revenue. Suppose, for example, that the station is equipped with 30,000 horsepower units, and that the sales price of energy is at the rate of $15 per horse-power year. If one of these units were out of commission for twenty-four hours it would represent a loss in income of $1,200! Accordingly, much is to be gained through strength and ruggedness of design and the adoption of a model of such simplicity that it will facilitate rapid dismantling, repairing, and reassembling when necessary.

The draft tube of a turbine installation is the passage through which the water on leaving the runner makes its way to the tailrace, and this conduit plays an important part in the turbine's effective utilization of the pent-up energy in the impulse water. Much study has been given to this feature; and at the Petty's Island laboratory there has been perfected what is known as the Moody spreading draft-tube. This tube is a great advance in the art, and is an indispensable feature wherever turbine runners of high speed are employed. By means of it it is possible to increase the vacuum just below the turbine runner, and in this way to regain, in effect, a large per cent of the energy in the water which would otherwise be lost after leaving the wheel.

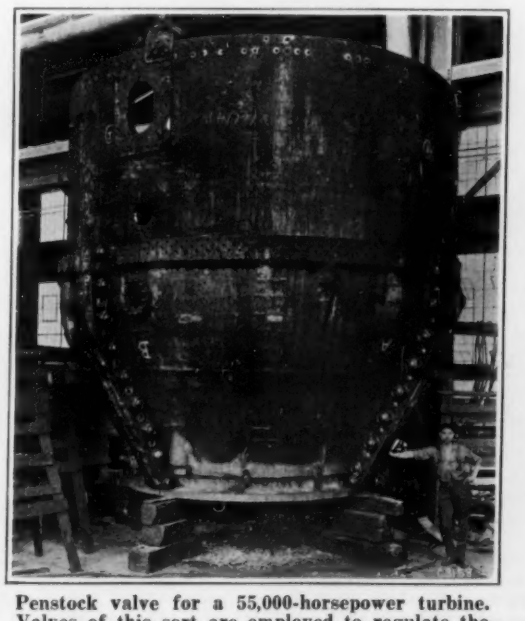


View of the recording station showing the dynamometer and scales for measuring the power developed by the model turbines, and the speed counter

As a reflex of the turbine investigations at the Petty's Island laboratory there has been developed the so-called Moody spiral pump. This pump marks the same progress in this particular field that is exemplified by the evolution of the high-speed turbine runners; and the improved pump admits of the use of electric motors that can be run at twice the velocity permissible before. As a consequence, complete pumping outfits can be manufactured and installed at greatly reduced expense. This is very desirable where large quantities of water are to be pumped under low heads. Previously it was necessary to provide rather costly low-speed electrical equipment.



The water passing over the weir. In the background can be seen the stilling racks for ironing out ripples and surges, so that the water shall run smoothly and quietly over the weir



Penstock valve for a 55,000-horsepower turbine. Valves of this sort are employed to regulate the volume of water passing on to the turbine

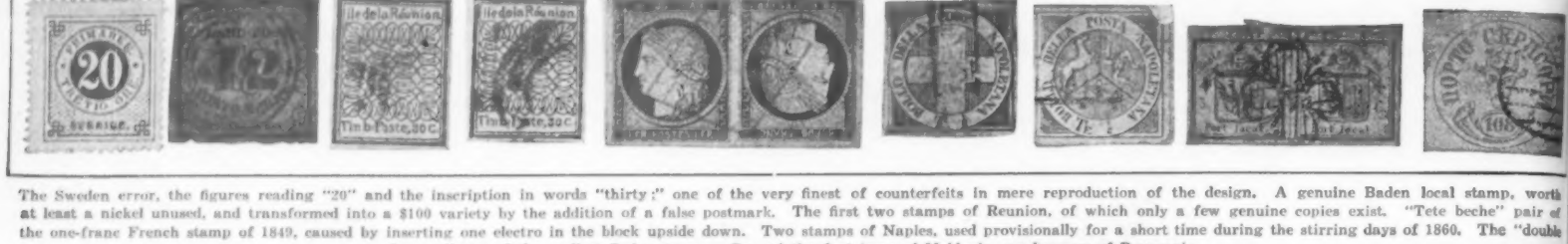
The laboratory on Petty's Island has a concrete headrace, tailrace, and return tanks. The water is lifted by means of motor-driven centrifugal pumps into the headrace tank, where the model turbine to be tested is placed. Model runners 16 inches in diameter may be tried out under heads up to 12 feet and in conjunction with various types of intakes, castings, and draft tubes. The water, after it has gone through the turbine, the draft tube, and into the tailrace, next flows into the tailrace tank and then over a weir where it is carefully measured by the volumetric method. From the weir it passes back by the return tank to the suction of the pumps. This completes the cycle. The effective head on the turbine under test is registered by differential gages attached to the headrace and the tailrace tanks; and the power developed is indicated by an Alden dynamometer upon direct-reading scales.

All readings are taken simultaneously at half-minute intervals agreeably to a signal bell controlled by a master clock. In this laboratory it has been found practicable to make comparative tests of the same runner or turbine when associated with different forms of draft tubes, all other conditions being the same, and by this means to arrive at an exact comparison of the effective value of the various types of draft tubes used. It was in this way that the 10-per-cent increased efficiency of the Moody design was indisputably established.

It is out of the question to discuss the numerous other factors that affect the working of a hydraulic turbine and which are studied at the laboratory in order that the force of falling water can be converted into mechanical power and then into electrical energy for transmission near and far. But it is well to emphasize that the steam turbine is no more highly specialized in its technical requirements than the water turbine. Finally, it should be kept in mind that the hydraulic engineer is today employing heads of water ranging from 10 feet or so up to 680 feet in water-power plants built or building in this country, and he is cunningly controlling these columns of water in operating turbines varying from a few hundred to 55,000 horsepower per unit. These installations would not be feasible, safe, efficient, and dependable but for the revelations and the momentous aid of the laboratory.

The Effects of Thirst

INVESTIGATING the effects of thirst on young albino rats, Tokuyasu Kudo, of the Institute of Anatomy, University of Minnesota, finds in the *Journal of Experimental Geology* for July, 1921, that albino rats about one month old may be held at constant body weight for several weeks by restricted amounts of liquid (milk) in a diet otherwise adequate for growth. The rats show a progressive tolerance of thirst, so that less liquid milk is daily required for maintenance as the experiment proceeds. The tail becomes elongated while the body length remains constant. There is in general a marked increase in weight of the skeleton and a slight increase in the visceral group. The musculature remains nearly constant in weight. There is a slight decrease in the integument and a marked loss in the "reminder." Of the individual viscera, the hypophysis, eyeballs, kidneys, suprarenals, spinal cord, skeleton, sciatic nerves, pancreas, stomach-intestines, liver, and uterus show a definite increase in weight. The heart, brain, and lungs remain nearly constant in weight. The thymus, ovaries, parotid and submaxillary glands, spleen, testes, epididymides, and thyroid suffer more or less well marked decrease in weight. The growth tendencies of the various organs in the young rats during the thirst experiments correspond in general to those found in rats of similar age during underfeeding, although certain exceptions occur (testes and kidneys). Likewise, the results of the thirst tests (also those of the inanition experiments) show a general resemblance to those of similar character in adults. There are certain differences according to age, however, as well as according to the type of inanition employed.



The Sweden error, the figures reading "20" and the inscription in words "thirty;" one of the very finest of counterfeits in mere reproduction of the design. A genuine Baden local stamp, worth at least a nickel unused, and transformed into a $100 variety by the addition of a false postmark. The first two stamps of Reunion, of which only a few genuine copies exist. "Tete beche" pair of the one-franc French stamp of 1849, caused by inserting one electro in the block upside down. Two stamps of Naples, used provisionally for a short time during the stirring days of 1860. The "double Geneva," one of the earliest Swiss stamps. One of the first issue of Moldavia, predecessor of Roumania.

A group of counterfeits of standard rarities, which would be worth something like $5000 if they were genuine

Stamp Frauds and Their Detection

Some of the Means Adopted to Protect the Collector from Forgeries

By the Philatelic Member of the Staff

THE bulk of the stamps which the non-collector sees have no intrinsic value. They retail for a cent or two apiece, but this merely covers the cost of handling them. There are perhaps 25,000 varieties from all over the world that have a true market value based on rarity and demand. Those costing less than a dollar are apt to be neglected as trash; and as we approach the hundred-dollar class the market is, of course, limited. Nevertheless the real rarities, of which the known copies are numbered, come as high as five and ten thousand dollars, with plenty of buyers to absorb the limited offerings.

With such values and a free market, fraud is bound to be attempted. Most counterfeits are made of whole cloth. But whether the design be reproduced with the aid of a camera or by hand-engraving, it will not correspond exactly with the original. With hand-engraved counterfeits, the expert examines the details of the stamp for points of divergence from the known genuine design. The photographic reproduction is more faithful in these matters, but usually differs from its original in the general effect of tone and shading, and often in size.

The expert has seen a number of counterfeits of any given stamp, and often has a reference collection containing many of these. If the specimen under examination fails to identify itself with any familiar counterfeit it must either identify itself with the genuine stamp or display divergence that marks it as a "new" counterfeit. The examination is conducted under a glass that magnifies two or three diameters. The experienced philatelist knows what sort of mistake the counterfeiter most easily makes, and what sort he can himself best see; so he knows just about what to look for and what parts of the specimen to examine most carefully. His work is quickly completed, especially when carried on in the presence of a genuine copy.

There are numerous exceptions to this statement. Many stamps of the '40s and '50s were printed in sheets of forty or thereabouts, each "cliché" being separately type-set or engraved by hand instead of impressed or electrotyped from a single original die as is done today. The various stamps on the sheet are then no more identical than an original and 39 counterfeits. The expert now has to decide, not whether the questioned specimen is like a single original, but whether it is identical with any one of a large number of originals. This multiplies enormously the difficulty of finding material for comparison. It usually means that complete material can be had only in the form of a photograph of a reconstructed plate, which is, of course, not an absolutely faithful standard. And it means that portions of originals or suspected copies that are veiled by cancellations can not be directly compared.

This makes contributory testimony from other quarters of value. A rare stamp is rare because there are not many of them; and while early inks were not constant, it is easy to establish that certain shades are right and others not. Again, one of the most dangerous counterfeits known, so far as surface externals go (the famous Sweden error illustrated), is printed on a paper totally unlike that of the original stamp, in color, texture and thickness. Paper and color, seldom used as an absolute test, are of great value in attracting suspicion to a counterfeit of good surface appearance, and again in helping to swing the verdict in a doubtful case.

Then there is the watermark which appears on many stamps. This is a thin spot in the paper, introduced during manufacture, which transmits more light than the rest of the stamp and is visible under conditions bringing out this property. The faker can print an imitation watermark on the back in greasy ink, or he can scrape out a thin place of the desired pattern. Neither of these expedients defies detection for a minute, however; so of late years another and a better trick has been introduced.

By chemical process the design is washed off a common stamp of the same size and the same watermark as the one it is desired to imitate. One faker made a bad guess and printed an excellent forgery on paper got by cleaning a stamp with much too fine a perforation. But barring some such *faux pas*, paper thus secured is bound to be right. When the trick was new many such fakes passed a hasty inspection on the ground that the watermark was so obviously good that the stamp *must* be right. Now the watermark is merely contributory evidence.

Philately's most interesting—and most puzzling—derelicts are the stamps that are partly genuine and partly false. This apparent anomaly may arise in various ways. When an entire series appears in identical design, the labels of value alone differing, the value may be erased from the commoner stamps of the set and a substitute painted or printed in, converting the stamp into a rarity. Such work is done with amazing skill; and its greatest menace lies in the fact that the general appearance of the altered stamp is altogether that of a genuine copy.

Then there are surcharged stamps. The desire to use up old and obsolete issues, the sudden necessity for stamps that have not been delivered, governmental changes, and numerous other circumstances, give rise to stamps which bear an overprint, in ordinary type, of a new value, a validating word of some sort, etc., etc. Perhaps one-tenth of all collectible varieties are of this character; and usually the overprinted stamp is valuable out of all proportion to its worth in unsurcharged condition.

This is the faker's paradise. When the false overprint is hand-stamped detection is, of course, easy. When a press is used, with studied care in duplicating the type of the genuine surcharge, an almost microscopic measurement of the surcharge is usually neces-

Left: Showing the use of the benzene cup to bring the watermark to visibility. *Right:* The perforation gage: the specimen is slid along the card until the diverging lines just coincide with successive teeth, and the gage of the perforation is then read off the side of the card. *Above:* The philatelist surrounded by his tools: magnifying glasses (one of larger power and smaller field than the other), dividers, benzene cup and supply of benzene, and tongs with which the stamp is being handled

Some of the tools of the stamp collector, and the manner of their use

At the extreme right is shown a genuine copy of the 10-centesimi value. The other ten specimens are counterfeits of various denominations of the same series, all of them being different, as a careful study of the inscriptions and frames will show. Presumably the entire series exists in each style of fake, since changing the numeral for the several printings would be simple enough

Ten different counterfeits of the same thing, and an original. The stamps are of Parma, one of the Italian duchies before the unification

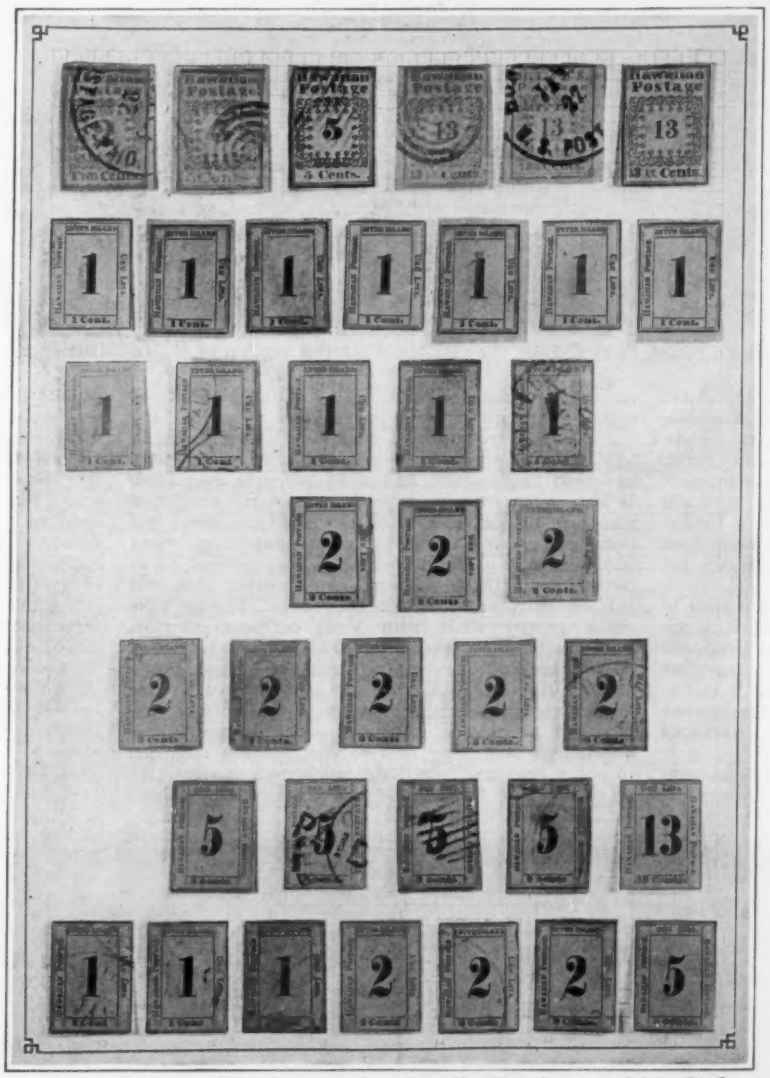
sary. If a variety of little value exists presenting the same overprint on a different base, one of these is cut in two through the surcharge and we have an automatic scale against which to measure the suspected copy. When this is not possible, measurements must be transferred from genuine to questioned overprint by meticulous use of the dividers. Less frequently the ink or the tone of the impression betrays the fraud. And sometimes the experf is blessed with pure luck. If, for instance, a French stamp overprinted for use in Madagascar appears with a beautiful Paris cancellation, examination need go no further.

An interesting development of recent years is a series of counterfeits, including several thousands of varieties, put out in Switzerland. The surcharged members of this family do not appear on genuine stamps. The entire piece—stamp, cancellation and surcharge—is forged. This, however, is exceptional; the average faker puts out his fraudulent overprints on genuine stamps.

In rare cases the unsurcharged stamp is the rare variety; the counterfeiter's task is then the removal of the offending overprint. A similar situation exists with reference to numerous British colonial stamps which were available for revenue duty, and when so used bear pen-stroke obliterations. In this condition they are practically without value; so the pen-mark is removed, and gum or a "phony" cancellation applied to create an unused or a postally used copy. When viewed at a very slight angle, almost parallel with the surface, these items always show the depression from which the mark has been removed. Moreover, original gum and substituted gum are two entirely different things.

Most fakes—especially those which bear a mark that it is desired to conceal—are of used stamps. One reason we have this instant suggested. Another is the present preference of most collectors for used specimens. Likewise, many collectors take a cancellation to be, within limits, an indication of genuineness. Again, in many cases unused "remainders" sold after demonetization by the post office are available for almost nothing, while cancelled copies can be manufactured from these which, if genuine, would be worth dollars, and in extreme cases hundreds of dollars. Finally, the cult of the used stamp has gone of late years to the length of collecting many special cancellations for their own sakes alone. The presence of such a postmark may raise the value of a stamp from a few cents to ten or twenty dollars—far more than the cost of unused copies. The close study of cancellations which results from this tendency, the exact knowledge of what obliterations were used and where, defeats the faker in his efforts to apply false cancellations, and when he tries to imitate the cancellation for its own sake. Occasionally it even aids in the detection of ordinary counterfeits to which "cancellations" have been applied to promote salability.

An amusing case recently occurred in connection with a large consignment of stamps sent here from Germany.



A page of early Hawaiians from a reference collection of counterfeits. If they were genuine, their value would be in the neighborhood of $13,000

The lot included a certain Providence local stamp on original cover. Unused, the stamp is worth a couple of dollars, while a genuine cover would be worth whatever you want to pay for it—surely a couple of hundred, and maybe more. Under the scrutiny of American experts it developed: (1) that the pen-mark appearing on the stamp in addition to the postmarks—in this case a rather favorable bit of atmosphere—was made with a steel pen and not with the quill of 1846; (2) that the postmark showing a numeral "5" in a circle should have lacked the circle; (3) that the "5" should have been Roman rather than Italic; (4) that the Providence postmark was dated three months after the stamp ceased to be available for postage. Aside from these trifling discrepancies, the cover was entirely genuine!

Among the actual tools of the philatelist scales and dividers and magnifying glass have been mentioned. Perforation gages are the most distinctive philatelic specialty. The size of the perforation frequently distinguishes between two varieties of the same stamp, and is of value in discriminating between genuine and counterfeit as well. The perforation is named according to the number of holes that appear in a space of two centimeters. Counting holes along the edges of many stamps becomes laborious, so gages which enable the perforation to be mechanically fitted against measuring lines or dots are substituted for counting.

But after all the philatelist's chief tool is the benzene cup. The stamp, ordinarily quite opaque, becomes semi-transparent when wet with this liquid. The stamp is somewhat transparent against the light when dry, so here the difference is not pronounced. But if we lay the dry stamp down on a black surface, what light passes through is completely absorbed by the black pigment. If, however, we then pour benzene over it, more light passes, and is now reflected back through the stamp from the film of benzene beneath it. This twice-transmitted light gives a remarkable picture of the internal condition of the paper. Watermarks, which are ordinarily difficult to pick out when held against the light, by reason of the confusion created by the design of the stamp showing through, show up like a sore thumb in benzene. Also, though the story is too long to tell here, the benzene cup gives the most satisfactory guard against the wiles of the stamp repairer. Modern philately makes a distinction between fine condition and poor which was unknown a generation ago, and has little use for a damaged specimen. The things that a skilled repair man with a bit of the artistic temperament can do to a soiled, crumpled, creased, torn, and thin-spotted wreck of a valuable stamp are almost past belief. But the consistency and the thickness of a repaired stamp are ordinarily sufficiently non-uniform to show up in the benzene.

The counterfeits used to illustrate this article are from the reference collection of Mr. Percy G. Doane, whose kindness in loaning them for the purpose we take this opportunity of acknowledging.

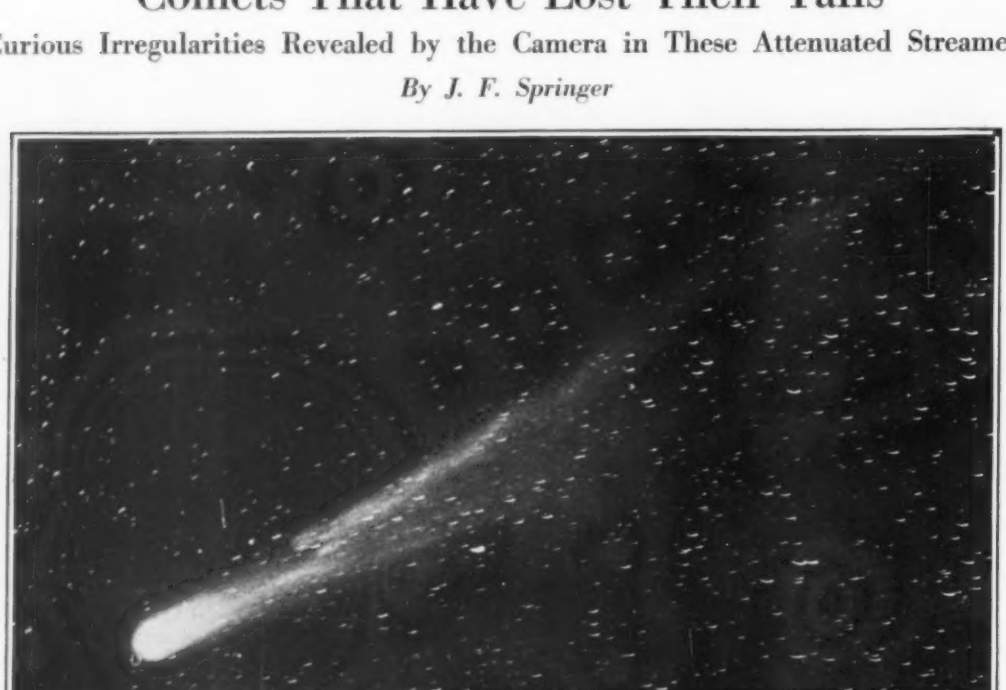
The first six items show counterfeit surcharges on genuine stamps. The inverted "2" is noteworthy. The 1, 2 and 8 centavo values are stamps that actually exist genuinely: the 12 and 18 are further values added to the set by the faker's imagination. The two Post-Office Mauritius stamps are probably the best known of the standard rarities: there are about ten of each value known to exist, and a fair price for the pair in fine condition would be $15,000 or more. Beside them is shown the cheapest counterfeit in the collection from which the pictures were made. The Uruguay stamp which it imitates is worth three cents in genuine copies. Of such counterfeits thousands may, with good fortune, be sold before it occurs to any buyer to examine them for genuineness

A final array of album weeds of more than ordinary interest

Comets That Have Lost Their Tails

Curious Irregularities Revealed by the Camera in These Attenuated Streamers

By J. F. Springer



Halley's comet, June 6, 1910, showing the discarded portion of the tail drifting away

AMONG the most notable of the objects to be seen in the sky are the visitors known as comets. I speak of them as "visitors," but this is only relatively correct. These bodies surely have their habitat in the surrounding universe and there is no very substantial reason to suppose they are able to get out of range of the gravitational spheres of the great mass of the visible and invisible stars. Comets come into visibility for the inhabitants of the earth and pass out of it again. They come into view suddenly and without announcement. And they never remain. So, after all, there is some justice in the term *visitors*.

Some comets, however, return with more or less regularity. Perhaps, the most notable example of a periodic comet is the one generally known as Halley's. This comet has been a notable one in the history, one of the most remarkable apparitions occurring in 1066 A.D., about the time of the Norman conquest of England. The Bayeux Tapestry depicts this visitation. Some periodic comets have periods of only a few years, while others occupy a great stretch of years in completing a circuit. Halley's comet returns at intervals of about three-quarters of a century. Some of the information obtainable with respect to the regular visitors is involved in a measure of uncertainty, largely because of difficulties of identification.

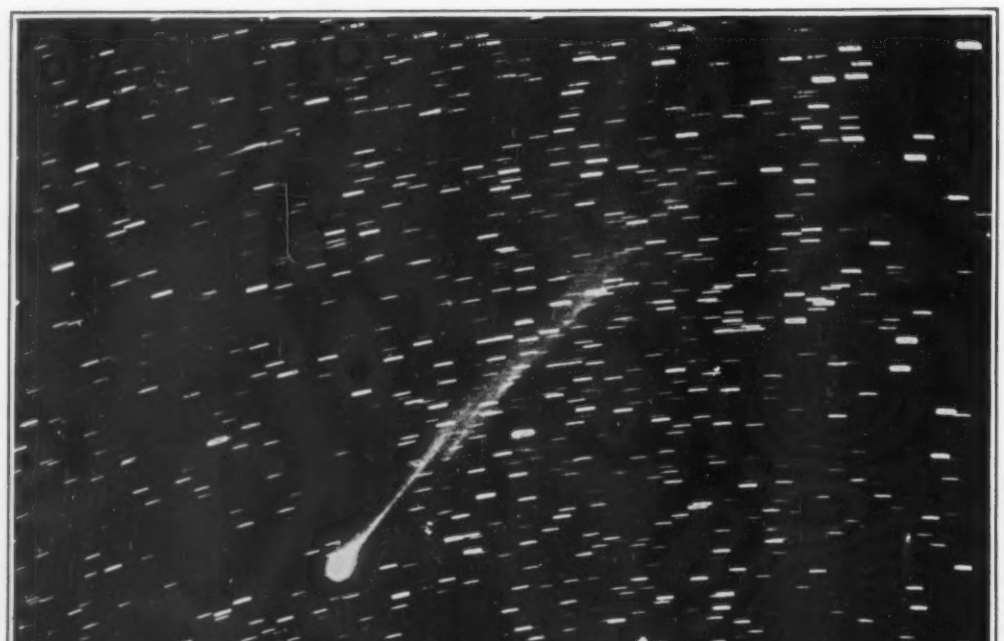
One of the most remarkable things about comets is the presence of a tail. Not that all have them. Many possess such appendages, and some make marvelous displays. However, the tail appears to be a transient affair somehow due to the comet's proximity to the sun. A periodic comet which displays a magnificent tail at one apparition may show little or nothing of this character upon another occasion.

As a typical comet swings swiftly round the sun, the tail seems to swing around as well. Always it stretches from the comet in a direction away from the sun. As the tail may be many millions of miles in length, an explanation is needed to cover the question as to how it is possible in a few days to swing the tail through an arc of 180 deg. Some comets are extraordinarily rapid movers as they round the sun. Thus, the periodic comet of 1843 reached, in its swing round, the wonderful velocity of 300 miles per second. However, it is more particularly the rapid angular swing of the tail that needs explanation. If the tail is precisely the same object throughout, a 72-hour swing of a hundred million miles of tail through two right angles would mean that the terminal particles covered an arc considerably over 150,000,000 miles long at the rate of some 600 miles per second. However, the tail may have a constant general appearance and yet at no two moments consist of precisely the same aggregate of particles. Examples of such objects are rivers, the flame of a gas jet, etc. It has been conceived that the tail may really consist of very minute particles of matter originating on the comet and swept off into space by the pressure action of light. The reality of light pressure seems to be admitted, and its intensity has been calculated. And light pressure may come to have a more intense effect than does the gravity of planetary bodies. Bodies on the earth are heavy not because a gravitative line of force is especially strong but because it operates within the body as well as on its surface. Light pressure exerts itself upon the surface only, and in fact only upon the one side, while gravity deals with every contained particle. Accordingly, the pressure of light upon a ball or a stone is insignificant compared with the force of gravitation. But if the ball or stone be reduced in size indefinitely a time will come when, because of the thinness, the pressure of light will equal the gravitative effort. We have now only to continue the reduction to get a pressure from light much greater than that of gravitation. Particles on an ordinary cometary body not too near the sun would feel but a slight gravitative pull as compared with the centrifugal thrust of light. Under the favorable conditions of the presence of quantities of very finely comminuted matter, a not too massive comet at a proper distance from the sun, and continued access of the sun's light to the material, it seems not at all impossible that the sun should drive off the particles in the form of a continuous jet, and that the tail so far from being an object perpetually identical with itself might really consist of minute particles receding at tremendous rates of speed centrifugally from the sun. The tail would thus consist of a jet of particles, the jet being perpetually renewed at the comet and perpetually dissipated at the far extremity. Such a tail could, if the rate of recession of the particles be sufficiently swift, swing rapidly through 180 deg. even if the length of tail be very great.

However, the material for the tail must be continually supplied from the body of the comet, which would accordingly suffer a diminution of its mass. Out in space, the particles coming away from the tail would seem to be forever under the influence of the centrifugal thrust of light from the sun, the only chance of escape being the advent of a shadow or approach of a body of high gravitative force.

But the flame-like tail is not always constant in its form, continuity and direction. A very recent comet, 1919b, lost its tail suddenly and started a new one. This occurrence took place about October 22, 1919, when the comet was some 6 days beyond the time of its nearest approach to the sun. This comet is really identical with the one discovered by Brorsen in the summer (July 20) of 1847. It was rediscovered in 1919 by Metcalf. The comet is accordingly periodic and its circuit is to be taken as about 72 years in length. It is classed as belonging to the Neptune group of comets, although this most distant planet of our solar system may not have been the cause of the closing of the orbital paths of the members of the group. Halley's comet also has an orbit whose aphelion falls in the region traversed by Neptune. In 1847, the Brorsen-Metcalf comet seems to have remained a strictly telescopic object. In 1919 the apparition made its appeal, though a very moderate one, to the naked eye. Discovered in August, it became distinctly visible to the unaided eye at or before the middle of September. Its considerable visibility continued until a few days after perihelion. At about the middle of its five weeks of visibility, it attained a magnitude of 4½ (Harvard scale).

Even in September, photographic reproductions of the object disclosed the presence of a tail. On the 22nd, it measured 3 deg. in length. The small stump shown in photographs of nearly the same date may very well



Borrelly's comet, July 24, 1903, showing transverse division of the tail. The long exposure (2 hours 37 minutes) results in unusually long star-tracks

The Brorsen-Metcalf comet, October 22, 1919, showing unusual diffusion of the tail

have been due to photographic conditions. On Oct. 3, there was again a 3-deg. tail. On the 6th and 7th, this length more than doubled; so that the photographs show tails 7 deg. long. The longest tail disclosed by the photographs obtained by Prof. E. E. Barnard with the Bruce photographic telescope was the one possessed at perihelion. It was 8½ deg. long.

On October 22, the tail was photographically observed as being in two parts. Rather, there was an old part no longer connected with the head and a new part extending from the head in direction 12 deg. from that of the old. The old tail at its point of nearest apparent contact with the head was still 51 min. (or nearly 1 deg.) from it. It is possible that part of the foregoing is not verifiable from the half-tone reproductions from paper prints. I am, however, following Prof. Barnard's own statements. The separation of the old tail from the head may, Prof. Barnard thinks, be disclosed in an earlier stage in the photographs of October 20—about 48 hours previous: "On that date, the tail proper seemed disconnected from the head. The rearward portion, which was sharply pointed, was 9'.6 from the head, while a new and widening tail filled the space between it and the head. If these parts were the same on the two dates, the recession of the particles was at the rate of 21 min. a day. Photographs made elsewhere will probably decide this question. On the photograph of October 20, a brighter condensation about 2 deg. long is shown in the tail 2 deg. 30 min. back from the head."

It is possible that one should have been prepared for the loss of its tail by a comet and the generation of a new one in a somewhat different direction by the phenomenon observed long ago of the display of fan-shaped tails. If a considerable arc can be filled at one time, it is not a great step to conceive of the arc being supplied in two or more parts successively. However, the actual loss of an entire tail does not appear to have been noted prior to 1903, unless one is to take account of Gale's comet of 1894. On July 24, 1903, Borrelly's comet lost its tail and forthwith started a new one. Two photographs appear to have been taken at the Yerkes Observatory upon the eventful night. In the earlier, taken by Prof. Barnard, there is a split in the appendage which separates the whole into two parts. That is, there is a break some 2 or 3 deg. back from the head and the portion from this point on was shifted to one side to a position parallel to the direction of the short part next the head. As the shift was on the side of the heavens from which the comet and its appendage were moving, the phenomenon suggested the idea that the old tail had become separated from the head and was being left behind. The second photograph, taken by Mr. R. J. Wallace on the same night as the former one by Prof. Barnard, disclosed the same general features, only in a further stage of development. Photographs taken on the nights of the 23rd and 25th show nothing unusual; so that what occurred in the interval was an event of short duration. The following details will be of interest: The earlier photograph showed a tail next the head 2 deg. 51 min. long; while the later one disclosed this same member as 4 deg. 7 min. long. As the interval between exposures, center to center, was 2 hrs. 59 min., one allows that length of time for the increase in length. Upon this basis, one puts the growth at about 25 min. per hour. The recession of the discarded tail is in contrast with this. The earlier photograph showed an interval between head and lost tail of 2 deg. 14 min.; while the later view disclosed the same interval as one of 2 deg. 48 min. The recession is, then, to be taken as about 12 min. per hour—or approximately one half the rate of the growth of tail.

Brook's comet of 1893 is notable as one which disclosed a variation in the direction of the tail of 15 deg. in the course of 24 hours. See SCIENTIFIC AMERICAN, August 8, 1908, for views of this comet. On one night, the general direction of the tail agreed pretty closely with that of a radius vector centering in the sun and passing through the comet. On the following night, the tail had apparently shifted, as it was now at an angle of about 15 deg. with the radius vector. Is this to be taken as indicative of an expulsive force emanating from the comet itself and competent to modify the general law to the effect that the tail extends along the radius vector?

Morehouse's comet belongs to the year 1908. Upon the night of September 30, a fan-like tail was discovered by a Yerkes photograph taken early in the evening. Later on during the same night, a photograph shows the tail with a very narrow connection with the head. The tail itself "appeared cyclonic in form and structure." By the following night, the appearance had undergone a very remarkable change. There was a mass of cloud-like material at a considerable distance from the head, and next the head a number of rays. Some of these are short, but others perhaps extend out as far as the cloud-like mass. Apparently, what has taken place in the interval between the views belonging to the two nights was the loss of the tail and the generation of a new one. The cloud-like mass is to be considered the tail of the night before that was seen with only a narrow connection. It would seem as if we must reckon Morehouse's comet (1908) as one that lost its tail.

Halley's comet in its visit of 1910 disclosed upon the night of June 6 some remarkable features. Upon this night, a photographic observation discloses that a secondary head was to be seen about 1.°61 back from the comet proper. This head had its own tail, only its direction from the main tail belonging to the comet itself was at an angle of about 15 deg. This tail was traced on the plate made by Dr. H. D. Curtis at Lick Observatory as extending to a point 16 deg. from the nucleus. On a view taken on the night of June 5, there is to be seen a small streamer near the nucleus, which Dr. Curtis thought might have been the source of what was disclosed the following night.

All in all, the phenomena attendant upon cometary tails are perhaps becoming better understood because of the precision and sensitiveness of photographic methods; but at the same time new phenomena are brought to our attention by these same methods. Consequently, the problem is never solved.

Morehouse's comet, October 15, 1908. Here, as in every comet picture, the telescope, set to follow the comet, is in motion with respect to the stars, which make short tracks across the photographic plate

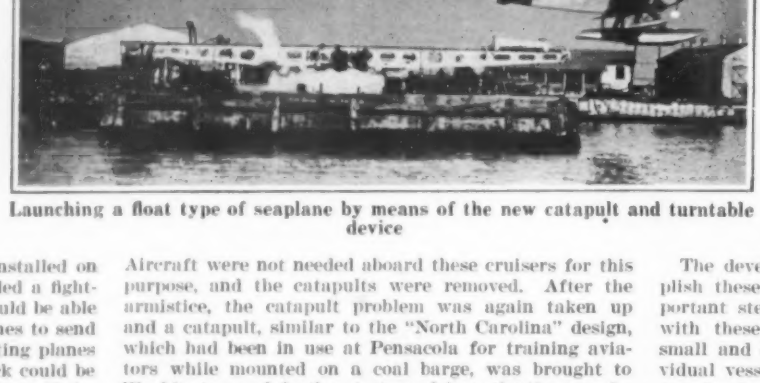
The Proportion of the Various Elements of Our Globe

SOME new data have recently been published by Mr. F. W. Clarke, under the auspices of the United States Geological Survey, with regard to the elements of which our globe consists so far as they are known to us. Oxygen constitutes nearly half (47 per cent) of the lithosphere, *i.e.*, the crust of the earth for a depth of 15 to 20 kilometers, and more than 85 per cent of the hydrosphere, *i.e.*, the ocean. Next to this is silicon which is the solid element most widely found. Taking the three spheres together (air, water, and earth) oxygen represents about 50 per cent of them and silicon 25 per cent. Next in order are aluminum (7 per cent), iron (4 per cent), calcium (3 per cent), magnesium, sodium, and potassium (a little more than 2 per cent each) and hydrogen (less than 1 per cent).

A Catapult and Turntable for Airplanes

The Navy's Device for Launching Airplanes Into the Wind, Without Changing the Course of the Ship

IN addition to carrying aircraft on special vessels known as aircraft carriers, it is anticipated that fighting and spotting planes may in future be carried on battleships and cruisers, although it is clearly impossible to provide these ships with the flush deck as in the case of the carriers. To permit the launching of airplanes from a battleship or other war vessel, the catapult has been resorted to, and a special type of catapult has been developed at the Philadelphia Navy Yard which has been designated a turntable catapult because the catapult mechanism proper is mounted on a turntable so that it can be pointed into the wind when launching a plane. One catapult of this type could be installed on every battleship and could launch when needed a fighting airplane, so that a fleet of battleships would be able upon the approach of hostile bombing airplanes to send into the air instantly a large number of fighting planes to shoot them down before the bombing attack could be developed. This is the real answer to the threat of the bombing plane, which was demonstrated in so spectacular a manner by the recent bombing from the air of the ex-German warships.



Launching a float type of seaplane by means of the new catapult and turntable device

In the bombing attacks of these ex-German warships it was shown that bombs dropped from the air could do material damage to warships which did not defend themselves. Obviously a warship can defend itself by anti-aircraft gunfire, but better by attack in the air. The weapons of offense and defense in the history of Naval Warfare have always developed step by step and the development of the heavy bombing airplane is being met by this development of a catapult which will shoot fast combat planes from the decks of battleships into the air to repel bombing attacks.

The catapult of this particular type is new, but the elements are the result of Navy catapult development initiated in 1911 by Captain Washington I. Chambers at that time in charge of Naval Aviation experiments. The first flight was made November 12, 1912, by Commander, then Lieutenant, T. G. Ellyson in a Curtiss seaplane from a catapult. This early catapult was highly experimental, and while the first flights were successful the device was not entirely satisfactory. The matter was resumed in 1915 when the development of Naval seaplanes had proceeded to such a point that it was clear to the Navy it would be desirable to take aircraft to sea. A new design of catapult, based on experience with the first one, was installed on the stern of the armored cruiser "North Carolina," and successful flights were made. The "North Carolina" installation proved so reliable that similar catapults were installed on the armored cruisers "Seattle" and "Huntington," and during the early winter of 1916 successful flights were made from these cruisers. At the time the United States entered the war the principal Naval effort was anti-submarine in its object and the convoy of shipping. Aircraft were not needed aboard these cruisers for this purpose, and the catapults were removed. After the armistice, the catapult problem was again taken up and a catapult, similar to the "North Carolina" design, which had been in use at Pensacola for training aviators while mounted on a coal barge, was brought to Washington and further tests and investigations made. The result of this investigation led to the design of the present turntable type of catapult which has now been completed at the Philadelphia Navy Yard and mounted on the water front for practical testing with aircraft.

The old catapults, such as were used on the "North Carolina," consisted of a track along which a carriage was propelled by a compressed air cylinder. The airplane was mounted on this carriage, and as the carriage speeded up it released the airplane at the end of its run, allowing it to fly into the air. The track for this catapult was mounted along the center-line of the ship, and since it was necessary to launch the airplane direct into the relative wind, it was necessary for the ship to set herself on such a course that the wind blew in the direction of the catapult track. This maneuver, while entirely feasible, necessitated the ship turning out of formation, or heading upon some course which might prove very disadvantageous. For a battleship it is considered impossible to require the ship to leave formation and to head upon a course which is possibly of great tactical disadvantage only for the purpose of launching a plane. These considerations led to the development of the turntable catapult, which permits the ship to proceed upon its usual course in formation while the catapult is trained like a turret into the relative wind.

The turntable catapult consists of a bridge-like structure mounted on a turntable upon which there is the usual car which carries the airplane, and this car is propelled by compressed air. Frequent tests have demonstrated that it is possible to launch by such a mechanism any of the types of airplane or seaplane which would be carried upon a battleship.

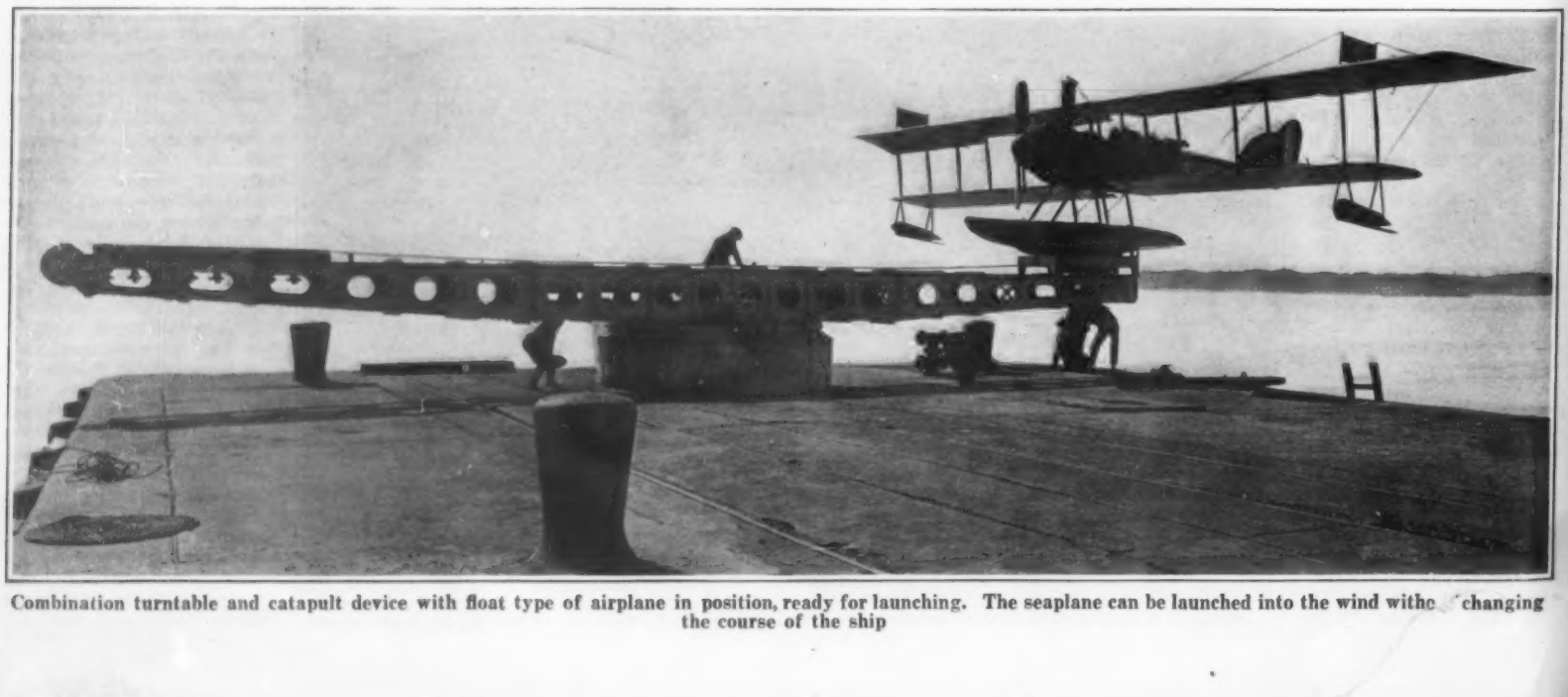
The problem of launching an airplane in a short run by means of the catapult depends upon several factors. The first and primary one is, of course, that at the end of the run the catapult should have given the plane a speed such that when the plane is released from the car the wings will lift it into the air and flight has begun. This requires that the launching velocity shall be *somewhat in excess of the minimum flying speed of the plane.* Second, it is necessary while the plane is being brought up to this flying speed that the plane be held securely to the launching carriage in order that it will not leave the track too soon. Finally, it is necessary that the acceleration of launching shall not be so great or so violent as to injure the pilot, who must ride in the plane and preserve all his senses alert in order to take charge as soon as he is released at the end of the run.

The development of a successful catapult to accomplish these desired things is believed to mark an important step in providing our fleet with aircraft, and with these turntable catapults, which are relatively small and compact, it is possible to provide the individual vessels of the fleet either with airplanes which can be launched from catapults when desired, but which will land upon an aircraft carrier when their mission is completed or, alternatively, the warship may carry seaplanes which can be launched from the catapult in a similar manner, but which will land upon the surface of the sea and be hoisted aboard like a ship's boat. Until such time as the Navy is provided with a suitable number of aircraft carriers it will be necessary to use seaplanes for work with the fleet. Under many conditions the seaplane in its present state of development is entirely practical, although in very rough weather a landing upon the sea is likely to mean the damage if not loss of the seaplane, although it is to be expected that the aviator can be rescued. The conditions of the weather, however, are not believed to offer any inconvenience to launching by means of the catapult, and in time of war the commander-in-chief will launch his planes in the air where they may accomplish their mission regardless of whether or not the planes may be salvaged intact upon their landing.

Discovery of Coal in Lorraine

IMPORTANT coal deposits have been discovered in Lorraine, according to a news item recently published in France. These deposits represent extensions from the south-southeast of the Saar Basin and roughly pass by the towns of Forbach, Pont-a-Mousson, Nancy, Luneville, and Mirecourt. In the first two districts 75,000 hectares (1 hectare = 2.47 acres) have been surveyed and have been found to contain a supply of coal from which it is said that the French could extract about 10,000,000 tons a year.

Stocks of coal in France at the end of July were estimated at 4,491,645 tons, there being 1,350,350 tons at the French mines, 269,179 tons in the Saar Basin mines, 536,130 tons at the French ports, and 1,663,200 tons with the railroads.



Combination turntable and catapult device with float type of airplane in position, ready for launching. The seaplane can be launched into the wind without changing the course of the ship

Vehicular Tunnel Ventilation

Tests In An Old Coal Mine, with Regular Automobiles, Under Operating Conditions

VEHICULAR tunnel ventilation tests under the direction of the U. S. Bureau of Mines, conducted at the Illinois Engineering Experiment Station and Yale University, have been described fully in previous issues of SCIENTIFIC AMERICAN and have been logical forerunners of the final tests now in progress at Uncle Sam's experimental mine, Bruceton, Pennsylvania, where a circular and tightly enclosed subterranean trackway 800 feet in diameter has been constructed upon which ordinary, average-sized automobiles are being operated in order to test out the proper dilutions that are essential to render the poisonous exhaust gases non-injurious to man. All these investigations are of basic importance as the results of these tests will be useful in solving the ventilation difficulties of the huge Hudson River vehicular tunnel, the largest underground passageway of its kind ever attempted.

Three unusual problems were involved in planning the ventilation of this tunnel which were unprecedented as far as engineering experimentation was concerned. It was necessary to ascertain accurately the amount and composition of exhaust gases from motor cars; the dilution essential to render these exhaust gases harmless; and the determination of the coefficients of air flow and horsepower required in model ducts, bends, and openings. Road tests were made on 101 different automobiles and trucks at the Pittsburgh Experiment Station of the Bureau of Mines, these machines being taken from active service without any additional adjustments so that the amount and composition of the exhaust gases were representative of actual operating conditions. The results of these tests showed that the percentage of carbon monoxide (the poisonous constituent of automobile exhaust gases) for the various cars varied from 0.5 to 14 per cent; passenger cars and speed trucks on level grades at 15 to 20 miles per hour averaged 7 per cent and 1½ to 5 ton trucks at 10 miles per hour averaged 7.3 per cent carbon monoxide.

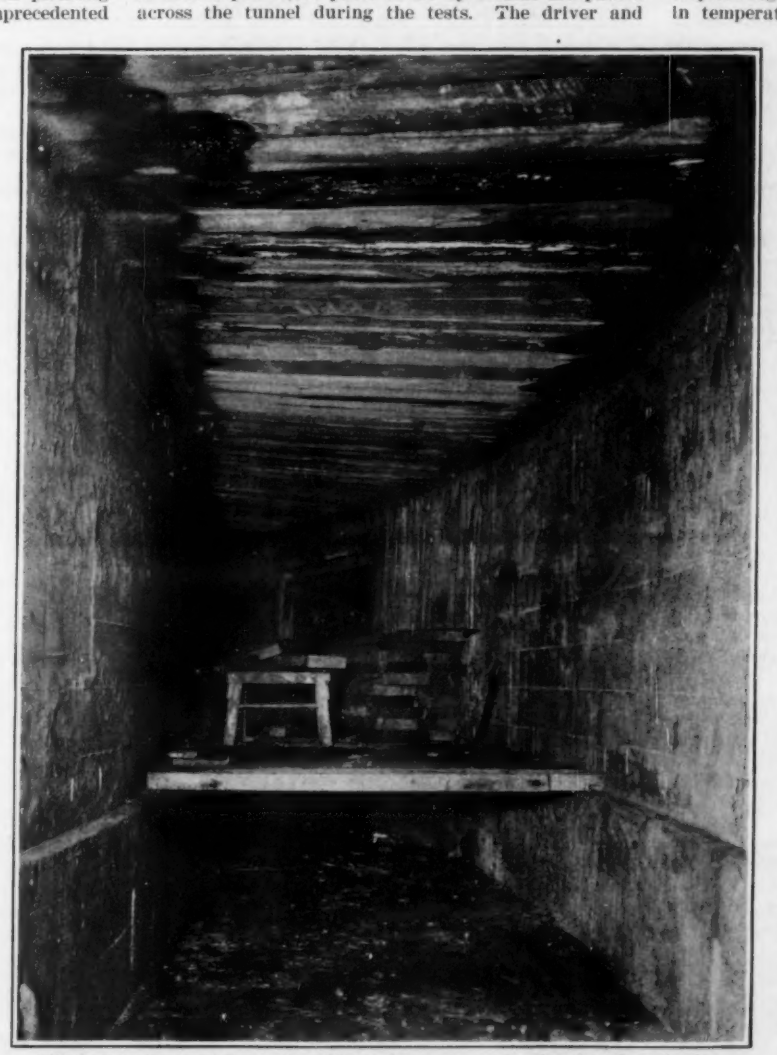
These data combined with a traffic count of the approximate number of motor vehicles which would use the tunnel per hour enabled the engineers to compute the total amount of exhaust gases that would be evolved in the underground automobile subway. Actual tests on men and animals were then conducted at Yale University to determine the largest proportion of these exhaust gases in the air that man could breathe without suffering any harmful effects. It was determined satisfactorily that when the exhaust gases were diluted with fresh air to the point where the concentration of carbon monoxide did not exceed 4 parts in 10,000 parts of air, no harmful results were obtained. These results agreed with practical experiences of the government engineers with regard to the effect of carbon monoxide in mine gases, and around blast furnaces and gas producers. Subsequently tests were run in an experimental tunnel erected at Illinois State University at a cost of $50,000 relating to the best method of supplying the fresh air and with reference to the flow of air in a concrete tunnel and its ducts, bends, and openings.

The final check on the solution of all these problems is now under headway at Bruceton, Pennsylvania. An oval tunnel, or rather an underground oval track, having similar construction of ducts to those proposed in the Hudson River tunnel and an axial length of 400 feet, has been constructed through the channels and galleries of an experimental coal mine owned by Uncle Sam. The cross-section of this test tunnel is 9 feet wide and 8 feet high. Above the ceiling of the tunnel an air duct 3 feet high has been installed, and below the floor another air duct 2½ feet high has been built. Either duct can be used for introducing fresh air or for exhausting the contaminated air. The tunnel cross-section is sufficiently large for accommodating the smaller types of moderate priced 5-passenger automobiles.

The tunnel is completely equipped with sensitive apparatus for measuring the temperature, humidity, quantity, velocity, and pressure of the air in various parts of the tunnel. A total of 48 air-sampling tubes is installed on eight cross-sections of the novel test tunnel, in order to obtain samples for chemical analysis, for determining the diffusion and concentration of exhaust gases in various parts of the tunnel with different methods of ventilation. An important part of these experiments will be the comprehensive physiological and psychological observations made on the effects of temperature, humidity, rate of air flow, smoke and exhaust gases on the men driving the test cars.

Ten small cars of a popular make and model are spaced 40 feet apart and are run at a speed of 10 miles an hour through the underground passage. Twenty-one thousand cubic feet of air per minute, sufficient to maintain a concentration of 4 parts carbon monoxide per 10,000 parts of air by volume are passed across the tunnel during the tests. The driver and observer in each car are subjected to examination by expert physicians and psychologists after each test. The amount of carbon monoxide absorbed by each person during the trials is ascertained by examining a few drops of blood drawn immediately after the test is concluded. Remarkably sensitive methods of examining these blood samples have been perfected. The effect of smoke and temperature on the motor car drivers and observers are also carefully studied.

The underground miniature tunnel in the coal mine is being used in these check experiments because it more accurately represents conditions which will prevail in the Hudson River tunnel when completed than could any above-ground model, no matter how painstakingly constructed and designed. It is situated 130 feet below the surface of the ground and 1050 feet in from the pit mouth of the mine. The temperature within the mine is practically constant and is free from unavoidable leakages of air which invariably obtain in above-ground models. The average ground temperature in the mine is about the same as that underneath the Hudson River. Means are provided for heating and humidifying the air to approximate the conditions that may occur on the hottest summer days.



800-foot test tunnel for automobile exhaust gases in abandoned coal mine

Tropical Geology and Engineering

IN an article on this subject, by Warren D. Smith, Acting Chief, Division of Mines, Bureau of Science, Manila, in the *Philippine Journal of Science*, the author discusses, first, the general geologic processes as they are found at work in the tropics, contrasting their effects with the same processes in the temperate regions of the earth; and second, cites some examples showing their practical bearing upon the engineering problems that arise in those regions.

It is found that the geological agents at work in tropical regions are the same as those found operating in temperate parts of the earth, with the difference that they are often greatly accelerated in the former. In the Philippines structural conditions are of prime importance in engineering. Both major and minor faulting occur here which as yet have not caused trouble save in mining operations.

In general it is found that in tropical countries like the Philippines both road location and maintenance are much more difficult than in the United States and Europe, and that both dams and reservoirs should be avoided if possible. Weathering of the rocks in tropical regions is notable. The so-called laterite, in some places of considerable economic importance, is a product of weathering. It is characteristic of many tropical countries. The author also finds that the geologic work of organisms is great in the tropics, though little studied, and that the work of tropical rain and running water is not appreciated as it should be. Handbooks and formulæ prepared by engineers acquainted only with conditions in temperate regions are worse than useless in the tropics. They are positively dangerous.

Engineers as a whole should, if possible, give more attention to the study of modern geology, which is no longer merely a descriptive subject, but is becoming more and more a close relative of engineering.

The Causes of Twins

IN an interesting article, of considerable length, on the experimental production of twins and double-monsters, in the *Journal of Experimental Zoology* for July, 1921, Professor H. H. Newman, of the University of Chicago, says concerning the causes of human twinning:

Davenport has recently published data that tend to show that monozygotic twinning is inherited strongly through the male parent. If this claim is valid, how could this fact be shown to accord with the general theory of twinning herewith expounded? If in human beings twinning be a result of temporary retardation followed by recovery, how could the sperm be responsible for retardation? It is evidently true that in human beings, as in other animals, there are varying degrees of compatibility between the eggs of some females and the sperms of some males. Doubtless the eggs of some females are totally incapable of fertilization by the sperms of some males, while quite fertile to the sperm of others. Doubtless also there are many borderline cases that involve relative incompatibility and consequent disharmony and retardation. If retardation be sufficiently severe, physiological isolation might occur at a relatively early period, which would likely result in completely separate twins; but if physiological isolation occurred relatively later, there would be a less complete separation of the twin bodies, and the resultant conjoined twins, cases of dicephaly, spina bifida, and other types of teratological duplication common in human fetuses. Thus twinning might be inherited through the male line owing to some peculiarity of sperm in a given race that has a retarding effect upon the egg. The entire subject is one richly deserving of further investigation, which will necessarily proceed slowly.

General view of the Germantown dam from below, showing conduit openings and hydraulic jump

The Hydraulic Jump

How Nature's Treatment of Rapids and Waterfalls Is Copied in Ohio's Big Impounding Dam

THE most important news of a year of progress on the history-making project in flood prevention at Dayton, Ohio, is that the hydraulic jump is a success. The hydraulic jump is a device for removing from the waters impounded behind the great dams in time of flood their destructive energy as they rush through the two concrete conduits which are the only outlets. Within the past year one of the five dams has been entirely completed, and this feature has been given a test more than half as severe as would be experienced in a repetition of the disastrous 1913 flood. In this test the performance of this hitherto untried device bore out the calculations of the engineers to a nicety.

In many respects the Dayton project is a pioneering venture. The principle of the impounding dam is new in this country. Under this scheme the three river valleys which converge above Dayton are blocked by huge dams. Concrete conduits are provided through the dams of sufficient capacity to more than care for the flow of the rivers. Thus in normal times there is no water behind the dams. But when the waters reach a flood stage the conduits are no longer large enough to permit the full flow of the waters and the excess backs up behind the dams, forming huge reservoirs. The waters in these reservoirs gradually flow off until the river again is within its banks. The capacity of these outlets is so calculated that at maximum flow the capacity of the river channel below the dams is not exceeded.

In addition to the three dams above the city of Dayton there are two smaller dams, one to protect the city of Piqua and the other the city of Hamilton. The so-called Germantown Dam across the valley of Twin Creeks, above the city of Hamilton, has been first completed, and here a short time ago occurred the first real test of the "hydraulic jump."

It might seem at first thought that the "hydraulic jump" is a matter of only secondary importance, whereas in fact it has been regarded as one of the most important features of the dam design and has been given more thought than perhaps any other. A design was not finally adopted until after a year of research and experimentation with various designs of outlet basin.

The importance of the problem may be realized from the fact that the water pouring from the twin conduits each minute at the crest of a flood of the magnitude of that of 1913 equals more than the combined energy of six fifty-car freight trains going at 37.5 miles an hour. Such tremendous destructive energy, if unchecked, would do great harm below the dam.

The mechanism is a simple one—an adaptation of a device often seen in Nature doing a similar work. We are all familiar with the usual deep pool at the base of a falls or rapids, which receives and absorbs the impact of the rushing waters, with jagged rock bottoms to further impede the flow. The problem was to convert this simple mechanism to the mathematics of the engineer, in order to design for strength and the greatest efficiency.

As finally worked out the outlet basin is built of concrete and bedded on solid rock, as it needs must be to withstand the impact of such powerful masses of water. It consists in a widening and deepening of the conduits below their outlet into a double concrete basin which opens downstream into the creek channel. Each conduit is thirteen feet wide, while the width of the double basin is 85 feet. The basin floor slopes down to an extreme depth of sixteen feet below the conduits. The bottom of the basin is built in irregular steps and obstructing walls are provided.

Both in this pool and in brook rapids, where the swift current strikes the slower water of the pool below there is formed what is aptly called the "hydraulic jump." In the case of the brook the "jump" is likely to be rather imperfect, whereas the jump in this basin takes the form of a straight stationary wave. The water from the conduits shoots into the base of this wave and by its momentum holds back the wall of water, which may be from six to ten feet high. The top of the wave constantly tumbles forward, giving the appearance of a great beach "comber," excepting that the wave does not move forward. One of the difficult problems of design was to locate exactly the spot where this wave would occur so that the engineers could meet in design the tremendous pounding of the water at this point.

There are three ways in which the "hydraulic jump" operates to destroy the velocity and kill the energy of the water as it issues from the conduits—by compelling it to do work in lifting the mass of water below, by means of friction, and by an effect which might be termed diluting the flow of speed by spreading it out over a deeper and wider channel than it had in the conduits. The water is churned into foam, and these millions of bubbles also exert a frictional retarding effect.

During the recent small flood the flow through the conduits reached a speed of 29 feet per second. The combined effect was to reduce this to a speed of 5.5 feet per second in the creek below. The actual effect, however, of killing the destructive force of the water was greater than these figures indicate, due to the fact that the power of destruction varies as the square of the speed. Thus a train going at 50 miles an hour, if it struck another, would smash things up with 25 times the force exerted if the same train were wrecked while going at 10 miles an hour. If this law be applied to the results obtained in this test it will be seen that 26/27 of the total destructive power of the water was "killed," and that only 1/27 remained.

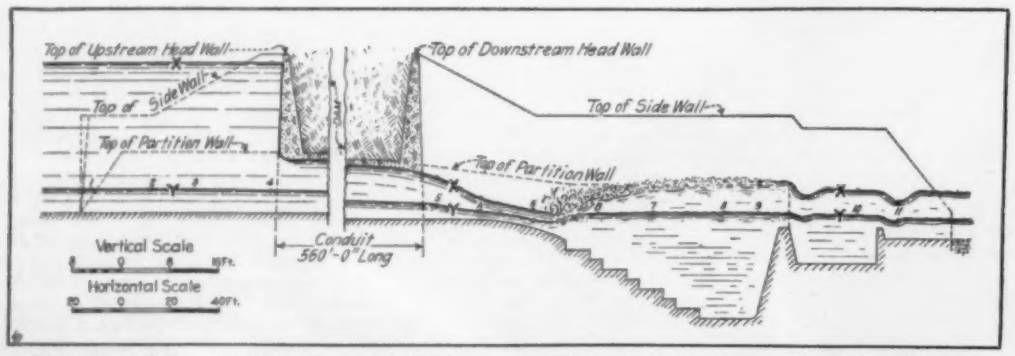
A novel feature of the operation of the conduits was the formation on the upstream side of the dam of a great whirlpool into which was sucked with irresistible force such objects as floated near it. Logs and great beams were seen to whirl about the edge of the maelstrom for a minute or two, then stand on end and disappear. Within a few seconds they were sucked into the conduits, traversed the 560 feet under the dam, and were shot out the downstream side.

Although the hydraulic jump formed the most novel and spectacular feature of the test, the general effect of the dam on the flood waters below it was recorded with no less interest. Although the storm was a small one, only 2.22 inches of rain falling on the Twin Creeks watershed, the water behind the dam rose to a height over half what would occur in a repetition of the 1913 flood, when twelve times as much water fell. This is because of the smaller area covered by the water during a small flood. Thus the flood was valuable as a test in a far greater degree than the amount of rainfall indicates.

Measurements showed that the effect of the dam was to lower the flood crest 3.25 feet below what it would have been without the dam. On the other hand, the waters remained high for a longer time than without the dam, due to the slow rate of release. The main point is that a high crest was avoided, and it is this feature of a flood which always causes great damage to life and property.

From these observations it is calculated that the crest of another 1913 flood would be lowered by this dam by 14 feet. Thus it is seen that the dam rapidly increases in efficiency as the size of the flood increases.

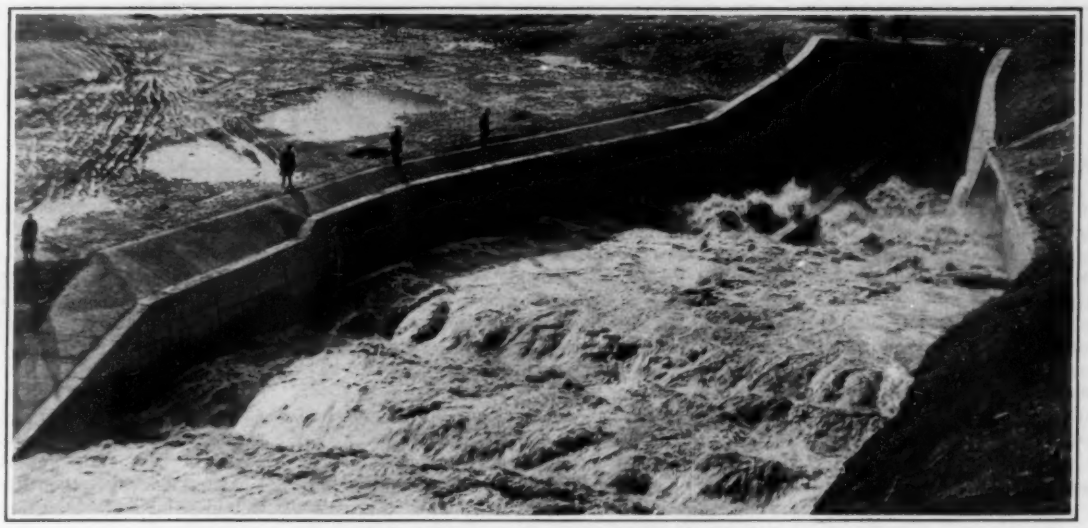
The construction of the dams and the channel work on the project has now reached a stage where it is confidently stated that if Dayton escapes any serious floods until this winter there will never again be danger of a repetition of the 1913 disaster, one of the greatest



Diagrammatic longitudinal section of the Germantown dam conduits, showing the hydraulic jump

ever to occur in this country.

With one of the minor dams completed, another of the important dams above Dayton will be finished by winter, and a second by spring. The third will then be near enough completion to care for a very large flood without danger. The plan has been, during construction, to make a great concrete P-shaped outlet to allow a somewhat free flow of water from behind the dams in case of flood, so as not to imperil the structures before completion. When the dam is brought to its maximum height a great concrete wedge is poured in this outlet, blocking it completely, excepting for the two conduits left through the base. At the same time the dams are nearing completion, extensive changes in the river channels are also being finished. It is expected that the job, at a total cost of over $50,000,000, will be completed by January, 1923.



Close view of hydraulic jump, showing the action of the water

The Legal Adviser in Foreign Trade

IN the general scheme of foreign-trade promotion the sales manager, the credit man, the foreign representative, and a score of other factors of varying importance—from the banker to the freight broker—have their recognized place and activity. It is only of late, however, that the business world has commenced to accord a growing recognition to the legal adviser as an essential, and occasionally the most essential, link in the organization of international trading.

So imperceptibly have the events of recent years drawn the lawyer into the councils of those who plan and direct foreign trade that the legal advisers of exporting merchants and manufacturers are frequently unaware of their own importance in the economy of foreign trade. Merchants and manufacturers engaged in foreign business had been seeking light on foreign laws long before their legal advisers thought enough of foreign trade to make it a subject of special study. And taking into consideration the vast interests involved in American trade with foreign countries, the equipment of the average American attorney when confronted with the legal problems of foreign trade has been, with a few exceptions, inadequate.

Now and then, in former days, the exporter's counsel had to prepare a power of attorney for use abroad; now and then he was called upon to present the proofs of claim in the case of a foreign bankruptcy; now and then he had occasion to make inquiries for some reputable attorney in a foreign land to take care of litigation, and the mysteries of foreign laws generally proved exasperatingly baffling.

The average lawyer, enjoying the confidence of his clients because of his familiarity with domestic law, was at sea when facing the laws of other lands. Even if he could lay his hands on foreign codes, frequently he could neither read nor apply them with any degree of assurance. He was like a conscientious general practitioner called upon to treat ailments which require the skill and the experience of a specialist. Foreign laws, he soon discovered, are largely the field of specialists. And such specialists until recent days, if not until the present day, have been very few.

Here and there a farseeing and daring American studied law abroad and sought admission to the bar of some foreign land. Such lawyers have established themselves in France, England, Italy, and Germany, in Brazil, Mexico, Cuba, Argentina, and a few other countries. Here and there foreign barristers associated themselves with American attorneys, and a bare handful of international commercial law firms sprang into existence, chiefly in New York City, and in a few foreign cities American lawyers associated themselves with native practitioners in a similar way. The few world-famed jurists specializing in international law in colleges or in diplomatic service, of course, are not available to commerce.

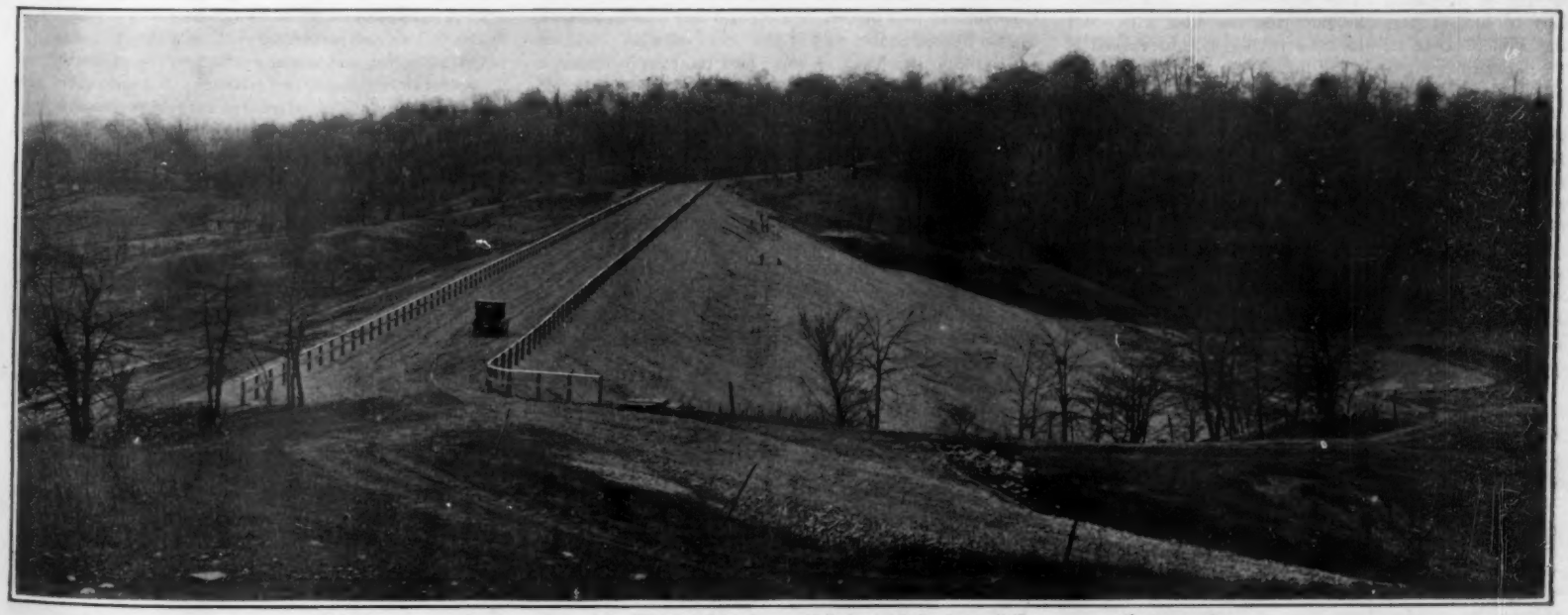
A considerable number of American attorneys, including the law departments of prominent corporations, have established working arrangements with legal confreres abroad selected with more or less discrimination and good luck. A still larger number rely on the unsatisfactory medium of printed lists of foreign attorneys. The vast majority have no foreign connections.

With regard to library equipment, one or two great law schools have excellent collections of foreign codes; one or two libraries of national fame have foreign law books on their shelves—but without any attempt at being either complete or fully up to date; a few law firms have built up libraries covering one or more countries; and several nonpracticing international jurists have law libraries of their own which include foreign law works. But the great body of the legal profession has no access to a complete library of foreign codes; has no worldwide network of legal coworkers abroad on the basis of any permanent mutual arrangement; and most lawyers are entirely at sea when their clients bring before them legal problems abroad for advice and attention.

The political and economic disturbances in the wake of the war have multiplied the legal difficulties of foreign trading. The business men of America have demanded more information on the subject of foreign commercial laws, and this need has been recognized in the creation of a Division of Commercial Laws in the Bureau of Foreign and Domestic Commerce which aims to compile laws, to collect codes, to edit them for use in *Commerce Reports* and eventually in special pamphlets, to collect foreign decisions of interest to American commerce, and to list reputable legal practitioners abroad. It can not, of course, undertake to render legal opinions or to prepare briefs—this is the province of the practicing lawyer. Much of this information is of technical character and requires the attention of the legal adviser, even as credit matters naturally come before the credit man and sales opportunities before the sales manager.

It is the legal adviser who prepares the power of attorney for the foreign representative; who draws up the incorporation papers when it is decided to form a branch or a subsidiary company abroad; who plans the entire policy of a firm before a new field of operations is invaded; who is consulted in the case of legal difficulties abroad; who studies the legal aspects and the meaning of letters of credit and of contracts of sale or of agency in foreign commerce. Not only the merchant and the manufacturer, but the bank, the insurance company, the freight forwarder, the shipping company find it indispensable to obtain legal advice on every phase of foreign business before they commit themselves. So the legal adviser of an American organization engaged either in active trading or in any of the auxiliary activities of commerce must study foreign trade in all of its aspects.

The American Bar is beginning to realize the potentialities of efficient service in the newly created Division of Commercial Laws, and many letters have been received from the leaders of the legal profession expressing interest in its work.—*By A. J. Wolfe*, Chief, Division of Commercial Laws, U. S. Department of Commerce.



Driveway over the top of the big impounding dam, with a partial view of the surrounding country

Our Point of View

REVIEW OF THE YEAR 1921

Civil Engineering

A GREAT part of the work of the civil engineer is devoted to overcoming obstructions which Nature has placed in the way of easy transportation of passengers and freight. Two notable examples of this are to be found at New York and San Francisco. At the former city the 30-year-old project for crossing the Hudson River by a great bridge has moved during the year into its preliminary stage of survey, design and organization. When this has been passed, construction will begin; and five years will suffice for erection. What the Hudson River, as an obstruction, has been to New York, San Francisco Bay has been to San Francisco and the great suburbs of Oakland and Alameda. Here it is proposed to cross the Bay by a 6½-mile structure, consisting of a great railroad fill, followed by a steel bridge across the shoaler portions of the Bay, and by a subway extending from the bridge to San Francisco below the main channel of the harbor. Each of these engineering works will be unprecedented in magnitude, the Hudson River bridge having a central span of 3240 feet, which is nearly twice the length of any existing span, and the San Francisco Bay crossing being from two to three times the length of any crossing of the same general character.

A matter of considerable importance to the bridge engineer was the report of the United States Bureau of Public Roads on the magnitude of the impacts of wheels upon the road surface, a question which has a serious bearing on the design of bridges. Too much in the past have designers been content to determine merely the static stresses, giving little attention to the question of the hammer blow of heavy and swiftly moving locomotives and cars.

The most interesting event in tunnel construction was the commencement of work on the great vehicular tunnel beneath the Hudson River between New York and Jersey City. Thanks to an unusually elaborate series of experiments undertaken by various technical bodies, it has been demonstrated that the carbon monoxide content in this tunnel can be kept at a safe low point by a properly designed system of ventilation.

There has been a fair amount of activity in hydraulic engineering and in the construction of dams and reservoirs. Work on the great Muscle Shoals Dam has been discontinued on the score of expense, and although an industrial magnate has offered to take the work over and complete it, we believe that the project is still in abeyance. The importance of this scheme may be judged from the fact that the dam will equal the Assuan Dam on the Nile in height and exceed it in masonry content. The most important proposed waterway is the Great Lakes-to-the-sea canal by way of the St. Lawrence. Its promoters aim, first, to open up a channel, sufficiently deep for ocean-going vessels, from Lake Erie to Montreal and second, to impound sufficient water to provide an enormous addition to the available hydroelectric power of this country and Canada. The canal would cost several hundred millions of dollars. It has been urged, and justly so, that the effort of the people of New York State should be devoted to the upbuilding of the traffic of their own State Barge Canal before lending assistance to what is, after all, a rival project.

Railroad and Automobile

Although little railroad building is being done, a glance at the map of the world shows that its civilized portions are not so badly supplied with this form of transportation. In the United States alone there are 256,572 miles of track, over which 1¼ billions of passengers and 2⅛ billions of tons of freight are transported annually, the cost of this great system being some 21 billion dollars. The railway mileage of all the world is estimated to be about 720,000 miles. Effort during the year has been directed to repairing the damages and making good the neglect of the war period. The tendency in the United States is toward heavier engines and larger cars. Weights and capacities are enormous. The most powerful passenger locomotive weighs 280 tons and is capable of hauling twelve to sixteen Pullmans at 60 miles an hour on the level; and the largest freight engine weighs 450 tons, and has actually drawn, of course at a moderate speed, a load of 17,000 tons on an up grade of two tenths of one per cent.

Increasing attention is being paid to the improvement of terminal and station yard facilities, with a view to increasing the average speed of freight movement. Port and terminal congestion has reduced the average speed of movement of a car of freight to the low figure of 20 miles per day. Having reached the limit of size, improvement in the locomotive must be looked for in the direction of improved efficiency, a problem to which increasing attention has been directed during the year. There is a tendency to increase the weights of rails. One hundred pounds is standard, and many miles of 130-pound rails have been laid. One leading authority claims that there would be a distinct economy in the use of 200-pound rails.

A development full of promise for safe and economical handling of freight is the container car, which is meeting with increased favor both in this country and abroad. There is a proposal, which should meet with every encouragement, to utilize the container car in conjunction with the motor truck by building the cars in such units as will match the dimensions of both freight car and motor truck. There is great promise of saving of both time and money in the prosecution of this method. The development of the motor truck goes on apace, and it is significant that the two greatest engineering projects for facilitating transportation, the Hudson River Bridge and the San Francisco Bay crossing, have received their greatest stimulus from the enormous development of automobile travel and motor-truck transportation of freight. The electrification of steam railroads where special conditions call for it has received additional endorsement from the successful operation during the year of the electrified mountain sections of the Chicago, Milwaukee & St. Paul Railroad system.

Naval and Military

A review of matters naval and military must start with the greatest event of the year—the calling of the conference in Washington by President Harding to consider the question of the limitation of armaments. The President is well placed to ascertain the sentiment both of the United States and of the great outside world on any big question such as this; and the hearty response to his invitation shows that all classes and conditions of men, political, naval, military, and lay alike, realize the folly and futility of overblown armaments and wish to reduce them to reasonable limits. During the year we have completed the "Tennessee," the last of our 14-inch-gun ships, and also the "Maryland," the first American battleship to carry a 16-inch gun. The close of the year finds our fleet unbalanced. We have the most powerful navy in respect to battleships and destroyers; but we have no battle cruisers, and we are relatively weak in our submarine and scouting forces. Expression of opinion as to the propriety of remedying this lack of balance, or suggestion of means for such remedy, are of course out of order while the possibility exists that the matter will be disposed of on other grounds than those of naval expediency; but we can at least suggest that greater effort should go toward the development of our submarine and airplane service.

The outstanding event of the year, at least in the public mind, was the great series of bombing experiments, when the ex-German warships were sunk off the Virginia Capes. The event was spectacular; and that was all. No new facts were developed. We knew, from land experiments, that bombs could be dropped so as to hit a stationary target, traced out on the ground. Hence it was no surprise to see bombing machines hit a stationary target moored on the water. Again, we knew that a heavy charge of TNT exploded below the surface in contact with a ship's bottom (the mine) would greatly injure, if it did not sink the ship. So, also, we knew that such a charge, exploded below the surface and near a ship's bottom (the depth charge) would damage or sink her. Hence the sinking of the battleship "Ostfriesland" by the detonation of 2000-pound bombs below the surface and a few feet from her hull, taught us nothing new. Had the ship been moving at 18 knots, with every anti-aircraft gun trained on the bombing machines; had the "Ostfriesland" been enshrouded in a smokescreen, made by friendly destroyers; had the bombers been subject to the disturbing elements of wind and weather—well, that would have been another story. In brief, nothing happened off the Virginia Capes to "sound the knell of the battleship."

Aeronautics

The outstanding fact in American aeronautics is that the United States is still awaiting the passage of a Federal law for the licensing of pilots, the inspection of machines, and the general encouragement and control of the industry. As matters stand, any man is at liberty to buy or build an inferior machine, take up passengers at so much a head, and kill both them and himself (as not infrequently happens) without a word of official protest. Thus, the art is discredited and the public discouraged. If aeronautics is not illegal, it is at best non-lawful and will remain so until Congress does its duty. While foreign governments are encouraging aviation, commercial progress in the United States is due entirely to the unaided efforts of the manufacturer and the individual inventor. All honor to them.

Some truly remarkable records have marked the efforts of the past year. In France, Sadi Leconte, in training for the Deutsch Cup contests, achieved a speed of 206½ miles an hour in a biplane, and came pretty close to that mark in the race itself. This was for a short distance, straightaway. The record over a 150-mile closed circuit was gained in the Pulitzer trophy by Bert Acosta in a Curtis Navy racer, when he covered the distance at an average speed of 176.7 miles per hour. Another startling feat was that of Lieutenant John A. Macready, who on September 28th, rising from McCook Feld, Dayton, Ohio, attained a height of 40,008 feet. He used electrically heated clothing, the oxygen tank, and the gas turbine supercharger. His LaPere biplane was the same in which Schroeder climbed to 38,180 feet in the preceding year.

The all-metal monoplane continues to gain favor, and its performance is characterized by a remarkably low gas consumption, due of course largely to its excellent motor. There has been a remarkable revival of interest in the monoplane as a good type for moderate speeds. The thickness of wing which is necessitated by internal bracing is unsuitable for the highest speeds. Leconte used a biplane with the characteristic thin wings of the modern racing machine. Multiple engines, so coupled up as to be capable of being run independently, are growing in favor. Martin and Gallaudet, among American designers, have secured excellent results with this arrangement. Regular airplane passenger service, running on schedule, has made progress, slow, it may be, but encouraging. Abroad, the French and British are still maintaining their London-Paris routes; other services in Europe have been running consistently, and new routes have been established during the year. On this side of the water we have seen the inauguration of the Key West to Havana and other passenger-carrying services. The Air Mail has functioned with a regularity which should encourage Congress greatly to enlarge its scope. Mention should be made of the Petroczy helicopter, which, in tests, lifted itself to a height of 160 feet. It weighs 2000 pounds and is held captive for

Our Point of View

observation purposes, taking the place of the vulnerable balloon.

The prospects of successful dirigible passenger service have undoubtedly been set back somewhat by the offer of the British Government to give away its fleet of six dirigibles, coupled with the failure of any private company to accept the gift, and by the tragic loss of the latest ship "ZR-2." As we anticipated in these columns, the official report indicates that the frame of the ship was too weak to stand the bending moment developed by the sudden throwing over of the vertical rudder. Failure came in the frame longitudinals while they were under compressive stress. Always, this has been the weak point in the rigid type of construction. An important contribution to naval aviation was the successful test at Philadelphia Navy Yard of a catapult, turntable, launching platform, by which a plane may be launched into the wind without altering the course of the ship.

Pure Science

Telescope and spectroscope have often made revelations of a more or less sensational nature. It is not always that the announcement to which the lay mind reacts in a manner justifying the use of this term is the one which impresses the scientist as of extreme importance. Once in a while, however, an advance is of such nature as to appeal strongly to layman and scientist alike. Such a one is the outstanding astronomical development of the year 1921.

Always astronomers have speculated as to the actual sizes of the stars, and always they have had to confess that here was one subject on which they were as much in the dark as the man in the street. From the earliest times to the present day; whether viewed with the naked eye, with the most powerful modern telescope, through the eye of the camera, or by any other means which ingenuity had conceived or apparently would ever be able to conceive, the stars showed themselves as mere points of light—the nearest approach we know in the physical world to the mathematician's ideal point, without actual dimension. That the stars must be enormously remote to preserve this aspect in the face of larger and ever larger telescopes was sufficiently obvious even before the present generation of brilliant statistical astronomers began the analysis of the skies which showed figures on this matter of star distances. That some at least of them must be enormously massive and, inferentially, enormously bulky to give the combination of distance and brightness which observation revealed was likewise pretty plain. But that any direct means of measuring star diameters would ever be provided would, even two years ago, have seemed the wildest sort of a dream. Yet today it is brought down to a basis of cold fact; it has been applied to at least two of the stars which we had reason to believe were among the very largest; and the figures which it has revealed for the diameters of Betelguese and Antares are by all odds the most amazing which have ever come from the astronomer's workshop. Best of all, as suggested above, these figures and the procedure by which they are obtained and the knowledge which they give are of the utmost import rather than of mere casual interest to the student of the universe about us.

There is no obligation upon him who casts a retrospective eye over the past year to seek out further developments in astronomy to place beside or immediately beneath the extraordinary achievement of the measurement of star diameters. Nevertheless, there is one significant tendency of the present era which has come rather to a head during 1921 and which we do not wish to pass without a word. This is the alliance between astronomy and sub-atomic chemistry and physics—between the macrocosmic and the microcosmic. The student of suns and universes has discovered that the man whose business it is to look inside the atom and describe and explain what goes on there is in a position to throw great light upon the making and unmaking of stars and stellar systems. Specifically, his own hypotheses of the past two decades, as to what the colors and brightnesses and spectral conditions of the stars mean in the story of their development, he finds more or less definitely confirmed by the study of atoms and electrons. The physicist and the chemist can now tell the astronomer that the sequence of growth and decay which he has pictured as taking place in the stars makes sense and is in harmony with the behavior of matter. And, while they can tell him nothing new in the mere technique of spectroscopic observation and spectroscopic analysis of distant stars, they are now able to tell him much that he has not known about the innermost whys of the spectral lines of absorption and emission; and what they tell him makes him the more secure in the conclusions that he is able to draw from his spectra.

Another curious instance of the throwing of light by one science upon the outstanding puzzle of another lays us further in debt to the student of the atom and the electron. Many methods of estimating the age of the earth have been put forward—scarcely any respectable geologist or physicist but has suggested one of these. They all depend upon mere arithmetic, to the extent that we observe some condition like the salinity of the ocean or the thickness of the rocks or the amount of erosion in some deep gorge, and calculate how long it would take this condition to be brought about. They all are weak to the extent that they assume this process, whatever it be, to have taken place in the past at the rate of its observed occurrence in the present. The student of radio-activity now puts forward a phenomenon which, in the very nature of things, must always have proceeded at the same rate, namely, the disintegration of radioactive elements into other elements of lower atomic weight. On this basis an estimate of the world's age has been made which seems to be far more rational than any ever made before, and which we can well afford to accept as marking an epoch in the discussion of this problem.

The chemist and the physicist, too, are taking their cue from the student of the atom; so that it seems we may justly call this the age of such study. Realization of the extraordinary amount of power locked up in the atom has been with us for some years. But 1921 seems to have put upon a firmer basis of actual expectation the possibility that some day we may be able to put this power to work. The problem is being attacked, and the scientist of sufficient imagination to be interested in the big things of the future in preference to the little things under his nose feels no hesitation in predicting that the days of our dependence upon fuel and hydro-generated power and the other clumsy expedients which separate us from barbarism are numbered.

It would be out of place not to acknowledge the fact that much of the success with which we nowadays attack large problems like this one is due to the organization of research and the great resources that are put behind such organization. Nowhere has this achieved a greater measure of proved success than in the field of medicine, hygiene and biology. Our study of the phenomena of life itself is advancing to a point where we can take living tissue from a living animal and, long after the death of the animal from which it has come, keep it alive.

Without any wish to minimize the great gulf that lies between a small piece of comparatively homogeneous tissue and the complex organism of the higher animals, the importance of this achievement is such as to make it rank high among the year's announcements. Then there is that thing that has, through judicious advertising, taken such a hold of the popular imagination—the possibility that the recognition and study of vitamines will at last tell us why some foods are sufficient to maintain life and others are not. While still unisolated and therefore of quite unknown chemical constituency, vitamines seem to have come to stay; and although much of the work leading up to the present knowledge has been done in past years, 1921 must be recognized as a year of climax and, above all, a year of publication and application of results on a wide scale.

A review of the year's developments in the field of pure science would be incomplete without a word about the post-war revival of archæology. This is now in full swing, particularly in Egypt, but in lesser degree in Mesopotamia, the Americas, Greece, Italy, and elsewhere.

Electrical Progress

The past twelve months have been truly fruitful with respect to electrical progress. On the one hand the year 1921 saw several large projects completed, and on the other the discovery or rediscovery of electrical principles of far-reaching importance.

Among the large projects realized during the past year have been the numerous hydroelectric power plants throughout the world. In our country we have done very well indeed; the truth of the matter is that we are fast harnessing our last water-power resources of the first order. Very soon our engineers will have to turn to the more difficult and less profitable water powers, whose value is not quite so obvious to the present generation, pampered as it is through an abundance of natural resources.

Aside from hydroelectric developments on a vast scale, there have been numerous new power houses constructed. Owing to the high cost of coal and other fuels, these power houses are models of efficiency and present an interesting forward step over the practice of but a few years back. Still another phase of recent electric power development is the placing of the generating units close to the supply of fuel—at the mine, in a word. Thus we have seen the Germans build large power plants at the very edge of their brown coal deposits, for the good reason that the low-grade fuel could not be shipped any reasonable distance without costing more in transportation than it is actually worth in heating efficiency. In the United States we have also begun this practice of building our power plants at the mines, and transmitting electric power, instead of coal, to the power consumer.

It has been a rich twelve-month period for radio communication. The huge Radio Central, some seventy miles out of New York City, was little more than an idea at the close of 1920. The end of 1921 saw this station taking very definite shape, with twelve of the seventy-two towers in actual operation. The Radio Central, focusing the radio communications of a large number of European and South American countries on New York City, marks a vast stride forward in radio. Lesser developments, but none the less interesting and significant, have been the increased number of broadcasting radio telephone stations and the new appeal of radio to business men, farmers, professional men, and even our good wives who, heretofore, found no interest in the meaningless and monotonous dots and dashes. But now, with the radio telephone transmitters in ever-increasing numbers, a radio receiving set becomes nothing less than a listening-in post on a mighty interesting party line.

We have followed the promising work of Edouard Belin, the French inventor, dealing with transmission of photographs and drawings over wires. In October of 1920, M. Belin gave his demonstration between St. Louis and New York. But during the past twelve months he has extended his work to wireless, and succeeded in transmitting drawings from Annapolis to Malmaison, outside of Paris, and from Bordeaux to Otter Cliffs, Maine.

Other developments have been the interesting 1,000,000-volt transmission experiments of the General Electric Company's Lynn laboratory, the work of the two Danish inventors on a principle first discovered by Edison several decades ago, improvements in electric furnaces, and so on.

From Steamer to Sailing Ship

A Plea for the Two Hundred Wooden Steamers Built by the United States Shipping Board

THIS article is a brief for the fleet of wooden steamers which were built for the United States Shipping Board to assist in meeting the urgent demands of the late war. It is written in the belief that the action of the Board in ordering these vessels, to say nothing of the ships themselves, has been the subject of much unfair criticism and misrepresentation. So far as the action of the Board is concerned, we must remember that when the ships were ordered the submarine campaign was at its worst, and the call had come from our Allies across the water for "ships, ships, and yet more ships." They asked us to place at their disposal, and to build to the very limit of our capacity, anything and everything that could carry food, munitions, and men across the western ocean. We answered that we would; and set about the task at once with all our might. It was an emergency call; we adopted emergency measures.

Why the Wooden Ships Were Built

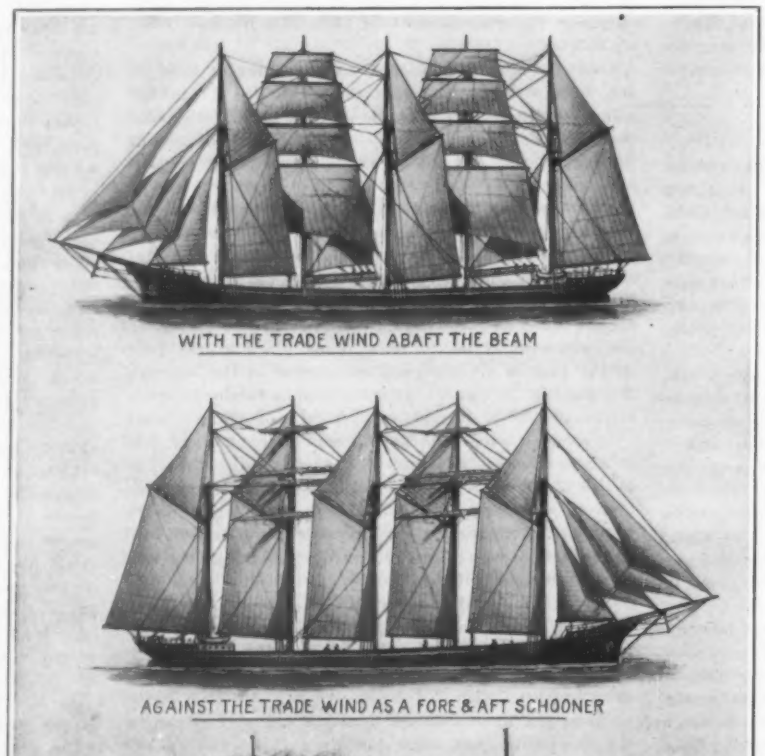
Many responsible critics have asked why in the world, with our vast steel works and our capacity to turn out ship shapes and plates in vast quantities, we should have put so much of our effort into building such out-of-date vessels as wooden steamships. The answer is that this fleet of ships was additional to the program for steel ships, and that their construction could be done rapidly and without hindering the larger program of construction. The vessels were built for a special purpose and to assist in meeting a great crisis. No one knew better than the naval architects who designed them that wooden ships of 3500 tons carrying capacity, if they were driven at 10 to 11 knots by steam power, could have only a limited life; but they knew also that these ships would be serviceable for the longest period of time that the war was likely to last. They were well designed for their purpose; but if there had been more time available they would have been built with the use of a considerable weight of steel strapping to increase their longitudinal strength.

Green Timber Not a Fatal Objection

Much has been made by the critics of these ships of the fact that they were built of green timber. Well, that was the only earthly way in which they could have been built in the limited time available. Moreover, construction of drying kilns capable of handling great timbers that were 12 inches square and from 40 to 60 feet in length would have been a task only less than that of building the ships themselves. The cost, furthermore, would have been prohibitive.

On this subject and others connected with the construction and the present and future value of the vessels we have just received a very informative letter from a naval architect, Mr. Charles I. Nielsen, who assisted in the design of these ships and is firmly of the opinion that they have a life of usefulness before them as sailing vessels. The statements which follow are digested from his letter, and we have prepared drawings showing one of these 3500-ton vessels, with its engines and midship deck structures removed and rigged as a five-masted compromise square-rigger and fore-and-aft schooner. Mr. Nielsen, who has had much experience in the construction of both steel and wooden ships, stands behind the statement that 80 per cent of these vessels are "as staunchly built as wooden ships can be," and that, if they are given the same care as other wooden vessels, they will be good for twenty years of service. He draws attention to the facts that the American Bureau of Shipping was responsible for their construction; that they were designed by responsible naval architects; and that the Bureau did everything in its power, within the limits of time available, to make these vessels as strong as possible for their work. A dead-weight carrying capacity of 3500 tons is very extreme for a wooden steamer, and the Bureau knew that for various reasons these ships could not last long as steamers. In the first place, they were designed to the ultimate limit of wood construction; for the exigencies of the war demanded that the design should be carried to the very limit in size. With care they would have carried on throughout the war; but they were never intended for continuous service as merchant steamers in after-war times.

So far as the use of green timber is concerned, our correspondent says that he knows of no large vessel that has been built of kiln-dried wood. Kiln-drying would have added some ten years to the life of these vessels; but the conditions were such that it could not be done. Our readers will remember that we published pictures of five-masted steam schooners of 3000 tons dead-weight, designed by Mr. Cox, formerly of the Construction Corps of the Navy. Although these vessels, forty in all, were built of green lumber, they were no better constructed than the Shipping Board vessels. They have given good service and proved to be well able to stand up to their trying, everyday work.



Lowest drawing shows U. S. Shipping Board wooden steamer, of which some 200 are for sale. Two drawings above show steamer as changed to a five-masted schooner, the engines, boilers, and midship deckhouses being removed

In some respects the Shipping Board's vessels have an advantage; for the steam schooners were built of fir, whereas the major part of the United States Shipping Board vessels were built of long-leaf, yellow pine, a stronger and more durable wood than fir.

Long-Lived Wooden Vessels

We are informed by Mr. Nielsen, who comes from Denmark, that there are vessels on the high seas today that were built of green fir in the Baltic over fifty years ago; and it seems that there are old-time war vessels at the navy yard in Denmark that are over 100 years old. These old craft make cruises every summer, and, according to our informant, they are good for another hundred years. Of course, the wooden ship has its limit in size, which is about 3000 tons; but by the use of diagonal steel strapping this may safely be raised on sailing vessels to 3500 tons, which is the size of the United States Shipping Board wooden vessels. Used as steamers, the ships would require a crew of 38 men; but if overhauled and rerigged, a crew of 16 would do.

How They Could Be Refitted

It would be a matter of straight shipbuilding work to remove the midship deck structures, leaving the fo'castle and poop. The vessels would be amply strong to carry a five-masted rig. With the boilers and engines removed, they could stow 3500 tons of cargo. Booms and mast could be utilized on the sailing rig, and part of the cargo winches could be retained and a small boiler installed to run them. If the vessel's bottom were given a good coat of boiling-hot brown tar and pitch and a layer of felt and composition covering they would be perfectly serviceable as sailing vessels.

The Compromise Rig

It is proposed to give the ships a compromise rig, providing a full fore-and-aft sailspread for windward work and providing a full suit of square sails on the second and fourth masts. Such a ship would be well suited for the North and South Atlantic trade winds. Going to windward, she could lie up much closer than a square rigged ship, and down the wind she could show a sail area of 46,000 square feet, as against 32,000 square feet when close-hauled.

Standard Specifications for Large Incandescent Electric Lamps

FOR about 14 years electric lamps have been purchased by the Federal Government under specifications published in Circular 13 of the Bureau of Standards. Progress in the art of lamp manufacture has been so rapid that this circular has had to be revised eight times in order to keep the specifications abreast with current developments.

The 9th edition of this circular has just now been published and may be obtained at 5c per copy from the Superintendent of Documents. The original specifications covered only carbon filament lamps while in the later editions metallized carbon and tantalum lamps were introduced and then discarded as tungsten replaced them in use. In connection with these radical changes in types of lamps, very great improvements were made in the efficiency and the life required, but no fundamental change was made in the form of the specifications or methods of testing. However, for the fiscal year beginning July 1, 1921, new specifications have been adopted which include important changes in the test procedure for tungsten lamps. The most notable of these changes is the abandonment of the long-distance provision that the life of test lamps shall be considered as ended when the candlepower has fallen to 80 per cent of the initial value. Now the life is considered as the total life of the lamp since the efficiency of tungsten lamps drops but very little up to the point of burn-out. The performance of a lamp throughout its life will also be taken into account and tolerances are provided to care for possible variations in test results where only a small number of samples of any one order are available.

Tests under these new specifications are intended to give a more complete indication of the performance of lamps than was the case with the former specifications and while prepared primarily for use by the departments of the government in purchasing incandescent lamps, it seems desirable on account of the thoroughness with which the subject has been studied and discussed to make the specifications available for the general public. It is for this reason that they are being used as the 9th edition of Circular 13.

Criticisms and suggestions concerning these specifications and lamp ratings are invited from both manufacturers and users and all such suggestions will be carefully considered in the event of a further revision of the specifications.

While dealing with the subject of incandescent lamp specifications it is perhaps wise to call attention to the article prepared for this issue by Mr. Luckiesh, the well-known authority on illumination, which appears on page 27. Illuminating engineering has made rapid strides in a remarkably short period.

Left: Section of burnt file blank showing decarburization; magnified three diameters. *Center:* Chill crystals in small steel ingot, magnified two diameters. *Right:* Overheated mild steel in section; magnification, 15

Three representative samples of British photomicrographic work of low magnification

With Eye-Piece and Camera

Recent British Developments in Petrological and Metallurgical Microscopy and Photography

By Albert A. Hopkins

IN the present article British practice will be considered, because, owing to her insular position, England was obliged to depend on her own resources during the war. She had to develop her optical manufacture in a phenomenal way, and her scientists led in the great advance of microscopical technique and the technique of photo-micrography. At a symposium held in January of last year by the Faraday Society, the Royal Microscopical Society, the Optical Society and the Photo-Micrographic Society, the best minds of the world of microscopy and allied sciences came together in a remarkable meeting held at the rooms of the Royal Society, Burlington House, London. Discussion of these papers took place in various parts of the country, and finally they were all republished in the Journal of the Royal Microscopical Society a few months ago.

The Petrological Microscope

We shall not devote very much space to the petrological microscope, except to show a good example of English make and to give a few generalities concerning the ideal petrological stands gleaned from the paper of Dr. J. W. Evans, F.R.S. The petrological microscope is constructed to serve two purposes. It is employed, in the first place, as an ordinary microscope, to observe the form and structure of the smaller features of rocks; and it is also used as an optical instrument for studying the action of minute crystals on light with a view to their identification. The latter function requires special features of greater or less complexity. The exact nature of these arrangements depends, however, to some extent on whether the material is examined in the form of a thin section of rock or in minute grains or fragments.

In all petrological microscopes provision is made for the examination of the object between crossed nicols, and for the rotation of these or of the stage, or of both alternatively. The advantage of a rotating stage and stationary nicols is so great from the point of view of simplicity of construction that it is always adopted in the cheaper instruments, and it is quite satisfactory in all cases where the work is confined to thin sections and methods involving certain special accessories or arrangements are not required to be employed. On the other hand, for the examination of grains mounted in oil or other high-refracting media, the use of a stationary stage and rotating nicols is practically a necessity, if high powers are to be employed, unless the Nachet device is adopted, by which the objective is attached to the stage and rotates with it. Rotating nicols are also necessary for the more complex optical methods, especially those that require an axis of rotation at right angles to the optical axis of the microscope, as when the optical characters of crystals are studied by means of the theodolite or "universal" stage. It deserves consideration whether, when rotating nicols are employed, a rigid connection between them should not be substituted for the gearing sometimes employed, even though the former is open to the objection that a rotation through a complete circle is not possible.

When crushed material or small grains are examined in oil or micro-chemical tests are applied the microscope should be protected by a shallow glass bath with a plane floor large enough to hold the glass slip.

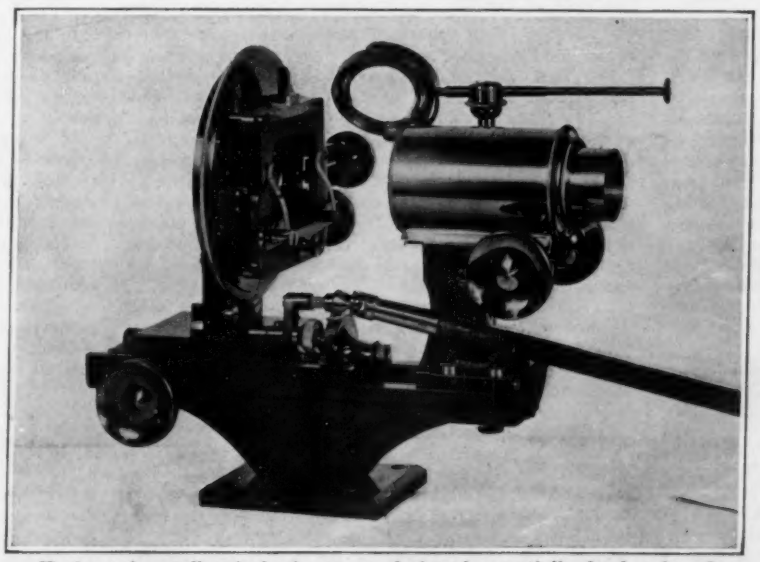
There should be a "mechanical stage" providing for the movement of the object in two directions at right angles to each other and to the optical axis of the microscope, so that the position of the object may be varied while its orientation remains unaltered. These movements and the fine adjustment should be accurately graduated.

Arrangements should also be made by which a nicol may be placed in a position above the eye-piece. At the same time a slot should be provided at the focus of the eye-piece, so that accessories, such as quartz wedges, may be inserted in focus. The upper nicol or analyzer, wherever placed, should be capable of rotation, either simultaneously with the lower nicol or polarizer or independently of it, and there should be special facilities for adjusting it at small angles of divergence from 3 to 6 degrees from the position of crossed nicols. This is useful in determining the exact position of extinction.

Metallurgical Microscopes

Now leaving the petrological microscope proper we come to the all-important question of the metallurgical microscope, and this subject was admirably treated in the paper by Prof. Desch of Glasgow, who stated that the use of the microscope in the examination of metals, first introduced by Sorby more than 50 years ago, has become so widespread that a microscope is now an indispensable item in the equipment of a metallurgical works, whilst the recognition of its importance to engineering works and other places in which metals are employed for constructional purposes is rapidly extending. It is therefore essential to the conduct of these industries that instruments should be available which will allow of the rapid and convenient examination of such metals as present themselves in the course of routine testing, whilst it is obviously desirable that elaborate and detailed investigation of specimens of special interest should be possible. It is quite true that any ordinary microscope of good construction may be used for metallographic work, provided the higher power objectives are duly corrected for uncovered objects; but the increased convenience of a properly designed instrument is so great as to justify its use, even for routine work. There are now on the market metallurgical microscopes of many patterns. Racks should be cut in hard, incorrodible metals or alloys instead of in soft brass, whilst the pinions might also be of much harder metal than is usually the case. It is probable that manufacturers have been too much guided by tradition in the choice of the metals to be used in the construction of scientific instruments: witness the tendency, only now disappearing, to use highly polished brass for heavy portions where cast iron would serve the purpose equally well.

There is no reason why the shape of the medical or biological microscope should be slavishly followed, especially when the question of photography is considered. The tripod form of foot so convenient in work by transmitted light is awkwardly in the way when examining metals and having occasion to use the rackwork movement for raising and lowering the stage. The racks and pinion should be geometrically cut in metal of sufficient hardness to withstand prolonged usage without working loose. The body tube should be of wide diameter on account of photographic work. A plain stage of fairly large size is suitable for most ordinary work. It should be provided with a rackwork focusing movement, but a fine adjustment is unnecessary. A central hole sufficiently large to allow an objective to pass through it permits the examination of heavy specimens resting on the foot, unless the support of the stage be arranged to swing aside entirely. Mechanical movements of the stage are essential for high-power work, and rotation is also a very great convenience, but when both are provided the rotation should be concentric. When a microscope is intended to be used in the horizontal position it is desirable to provide the mechanical movements with clamping screws, as otherwise a heavy specimen may cause a gradual downward slip during the exposure of a photograph plate, pulling down the rackwork by its own weight, particularly when photographing at high magnifications. The rotating circle should have a clamping screw. The examination of fractures, large crystals in ingot sections and other things requiring very low powers and great distances is troublesome when an ordinary microscope is used, and it is often preferable to employ a camera with a landscape or copying lens instead of a microscope. Illumination of the object has been given great attention in England and every metallurgist using the microscope and every manufacturer has his favorite. It is now very generally agreed that short mounts are to be preferred for metallographic objects. A high numerical aperture is necessary for the highest powers. Oil immersion objectives are of course necessary for the highest magnifications. Projection eye-pieces are to be preferred for photographic work.



Horizontal metallurgical microscope, designed essentially for benchwork

Through the courtesy of J. H. G. Monypenny, Chief of the Research Laboratory of Brown Bayley's Steel Works, Ltd., we are enabled to give our readers some account of the latest advanced practice along this line. Mr. Monypenny justly says that while the technique of the photomicrography of metals has advanced greatly during the last ten or twenty years there are still marked evidences that many who take up microscopic work in connection with metallurgy appear to study the microscope itself either not at all or only to a very small extent. The consequence is that statements are made about the structures of various metals which are not correct; the presence in sections of minute particles or membranes

of constituents, other than those stated to be there, has been missed simply because the operator did not know how to use his microscope properly. Again, photographs are published which have only a slight resemblance to the structures photographed; in some cases the definition is so bad that the reproductions are not worth the paper they are printed upon. One has only to look through the journals of, for example, the Iron and Steel Institute to see how true this is.

In his paper Mr. Monypenny has attempted to set out some of the conditions which appear to him to be necessary to secure good photomicrographs of metals and the means he has devised from time to time to fulfil these conditions. The following are some of the points raised.

The Illuminant and Condensing System with Metallurgical Work

Few who have had any experience in photomicrography will disagree with the statement that the illumination of the specimen is of fundamental importance in the production of a good photomicrograph. Good illumination should meet four conditions. The whole surface which is required to be reproduced should be evenly illuminated; the lighting should be such that the whole aperture of the objective may be utilized; the wave-length of the light used should be that for which the objective is corrected; and the wave-length of the light used should be suitable to the color of the specimen.

Fortunately, in most metallurgical work the specimens rarely call for the use of any definite color of light, and hence the necessity for complying with the last-named condition does not, in general, arise. This is a great advantage, as it enables one to adjust the color of the light to fulfil the preceding condition. In other branches of microscopic work (*e.g.*, in connection with biology), it may easily occur that the requirements under these two conditions are opposite, and then the photomicrographer has either to use a color for which the objective is not adequately corrected or one which is not best suited to the specimen.

The vertical illuminator, color screens, the relationship of aperture and magnification, are all very fully treated in the paper presented to the Faraday Society, but the means which Mr. Monypenny took to prevent vibration and ensure short exposure are worthy of more than passing mention.

Reducing Vibration for Photography

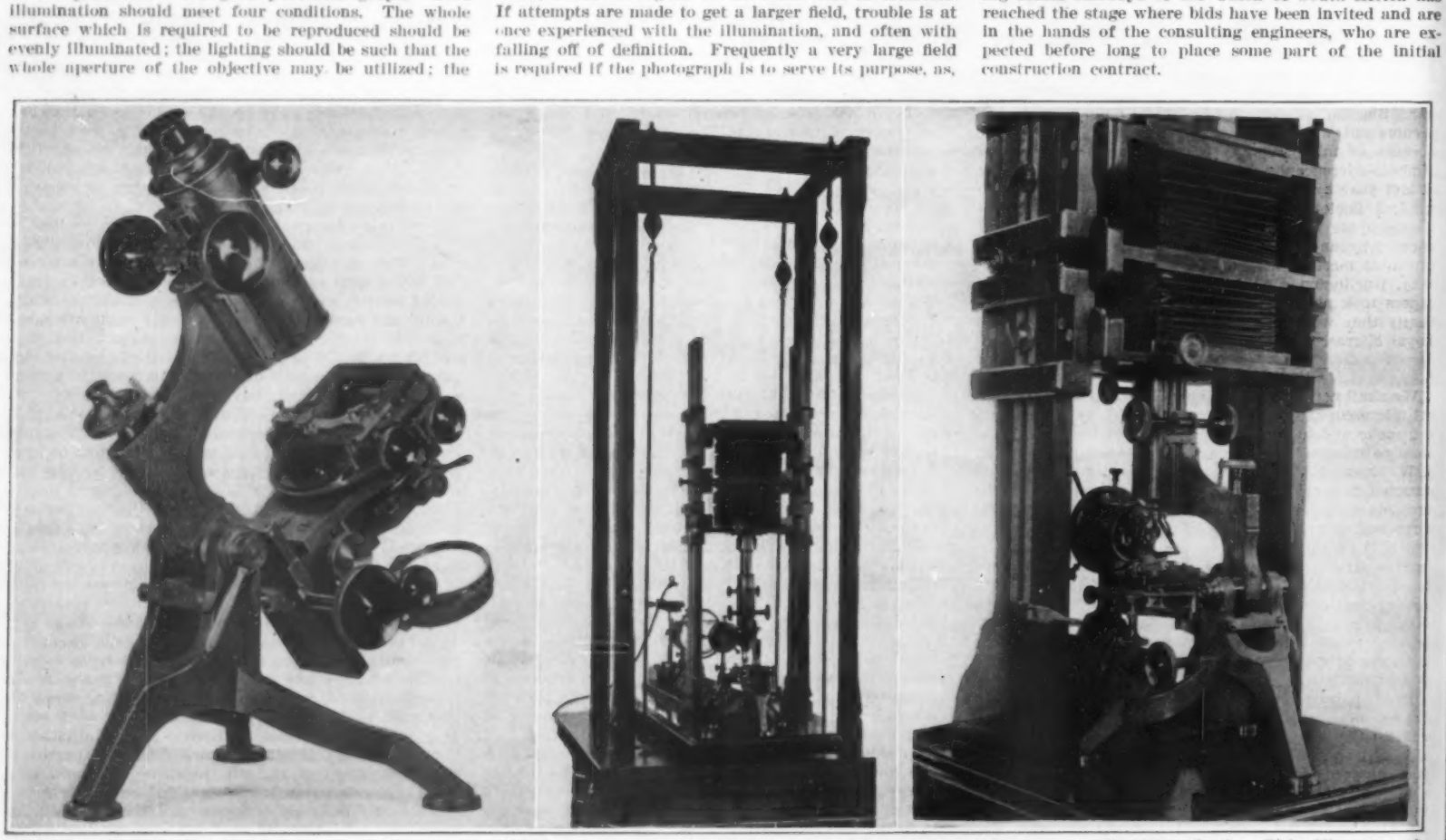
Even when the exposures are comparatively short (*e.g.*, a few seconds), they still give plenty of time in the case of the higher powers for vibration to have considerable effect. He has, however, been able to overcome this completely by swinging the whole photomicroscope on springs as shown. It will be noticed that the author's camera is vertical. This position has several advantages from a works' point of view; obviously it occupies less floor space than the horizontal pattern, and is probably more easily swung than the latter. It may be mentioned that, with the system of suspension used, photographs at 1000 and 1500 diameters were successfully taken, although the laboratory was within 50 yards of four 8-ton steam hammers, and also adjoined three sets of railway lines running into the works.

Low-Power Photography

It is frequently desirable to be able to reproduce at low magnifications fairly large areas under vertical illumination. With ordinary low-power objectives (*e.g.*, 2 or 3 inches), it is possible to take photographs at, say, 20 or 30 diameters, but in general the field is only small, about one-eighth or one-tenth inch in diameter. If attempts are made to get a larger field, trouble is at once experienced with the illumination, and often with falling off of definition. Frequently a very large field is required if the photograph is to serve its purpose, as, for example, with groups of flaws, very coarse structures, and segregated areas.

For such work the ordinary low-power objective is not suitable—its "field" is not big enough. The lens Mr. Monypenny uses is the 35-mm. projection lens made by Zeiss, though probably equally good results could be obtained with some of the very short-focus photographic lenses made by various opticians. As illuminator he uses a piece of microscopic cover glass 1⅞ x 1¼ inches, mounted in a light brass frame which fits on to the objective. The frame is pivoted, allowing the illumination to be adjusted to a nicety. This disk is used between the objective and section.

The illumination is similar in principle to that used in the enlarging or projection lantern, the condenser being close to the section and focusing the illuminant (after reflection at the cover glass) on to the objective. The condensers used are 2⅛ inches in diameter, and it is possible to illuminate evenly a section about 1 inch in diameter. For very low powers (*i.e.*, up to 7 or 8 diameters), a short focus photographic lens is used. It is obvious that these low powers are of special value where either the structure is very coarse or one wishes to show the variation in structure over a fairly large area. An American work on metallography will be reviewed in these columns by Mr. Monypenny shortly.



Left: A "works" metallurgical microscope, after Watson. *Center:* Photomicroscope arranged for high-power work, with spring suspension to prevent embarrassing vibration. *Right:* Microscope and condenser as arranged for low-power photography

The tools of the British commercial photomicrographer

World-Wide Activity in Steam Railway Electrification

DUE apparently to the marked increase in price of fuel which has taken place during the past few years, steam railroads all over the world are studying the possibilities of electrification as a means of lowering operating expenses.

Most of the leading countries in Europe have announced plans either to increase the present mileage of electrified steam railways or to carry out such work where hitherto electrification was not regarded as economically feasible. In South America, Brazil and Chile either have work under construction or are about to let contracts for such projects.

In Asia, Japan and India are both making investigations with a view to electrifying certain suburban or heavy-traffic sections. In Australia, the suburban lines out of Melbourne have been in process of electrification for some years, and other projects in that country are under discussion. In Africa, the question of electrifying steam railways of the Union of South Africa has reached the stage where bids have been invited and are in the hands of the consulting engineers, who are expected before long to place some part of the initial construction contract.

In the past, whenever the question of electrification has been taken up, the matter of increasing the capacity of a section of steam railway has probably been the greater factor, rather than reduction in operating expenses.

It is interesting to note that in many of the larger countries abroad the heavy trunk-line electrification projects in the United States have been very carefully studied and are very frequently referred to by foreign consulting engineers in their reports, and that in several instances standard American plans have been adopted practically complete by engineers advising foreign governments on steam railway electrification. It is believed that the experience of American manufacturers in developing reliable heavy railroad equipment in this country will be of considerable help in negotiating a foreign contract.

Paper Tile

PAPER from strong fiber containing tannin is soaked in a solution of ammonium sulfate 30, zinc chloride 6, sodium silicate 10, boric acid 10, and water 400, and dried, then painted with a mixture of asphalt 30, coal tar 40, drying oil 10, graphite powder 10, and asbestos powder 10, and finally with graphite powder. It is then rolled and dried.

Naval Construction in Japan

Facts and Figures Regarding the Strength of the Japanese Navy Today and in 1927

By Hector C. Bywater

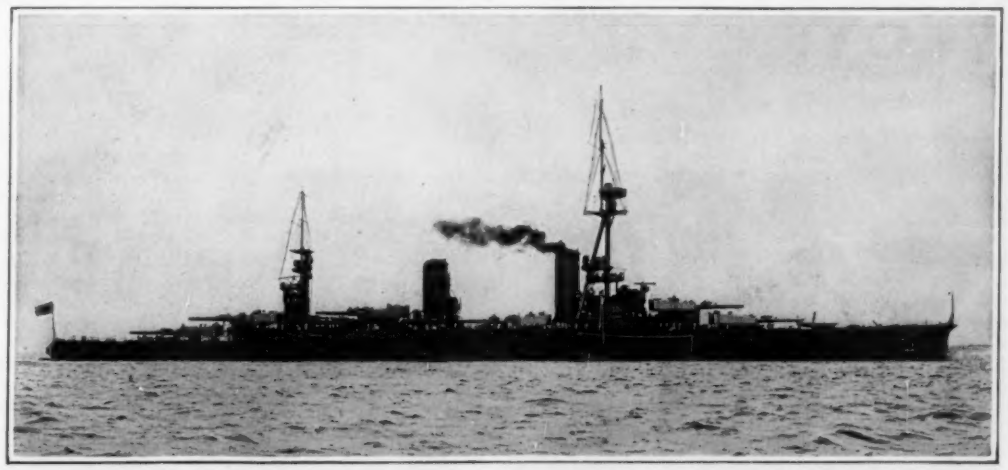
THE strength of the Japanese Navy, both at present and in the near future, has become a subject of deep interest to all who follow the trend of world affairs. Thirty years ago the sea power of Japan was a negligible quantity. Her navy was scarcely large enough to merit the title, and the fleet that won such a resounding victory at the Yalu River in 1894 was simply a cruiser squadron, though it contained all the effective ships then under the flag of the Rising Sun. But the success thus achieved by the young navy gave a great impetus to expansion, and when, ten years later, Japan found herself on the verge of war with Russia, she was able to muster a truly formidable fleet, including battleships, armored cruisers, and other vessels of the most powerful type. With few exceptions, however, these new ships had been built abroad, for Japan was not yet sufficiently versed in naval architecture to undertake heavy construction on her own account. In reviewing the development of her fleet since the war with Russia the most interesting fact to be noted is that practically all the ships which post-date that period have been built, armed, and equipped by native industry. In some cases, it is true, certain structural parts, machinery, guns, mountings, and armor were purchased abroad, but of late years the import of naval material has been very limited; and Japan, for all practical purposes, is now self-supporting in respect of naval shipbuilding and equipment. Her progress to this position of independence was hastened by the World War, for while that struggle continued she could obtain no supplies from Europe or the United States. She was therefore compelled to fall back upon her own resources, and these were so enlarged during the period of the war that Admiral Kato, the Minister of Marine, was able to announce last year that the whole of the naval construction then in hand would be built and equipped with none but Japanese labor and Japanese material. The literal accuracy of this statement is open to doubt, for it has since been ascertained that orders for several thousand tons of armor and a few sets of submarine engines were placed in England on behalf of the Japanese Navy. On the other hand, reports that certain capital ships and cruisers of the "eight-eight" program would be built in England have been authoritatively denied.

Battleship "Nagato," also "Mutsu." *Displacement,* 33,800 tons. *Speed,* 23 knots. *Armament,* eight 16-in.; twenty 5.5-in.; eight torpedo tubes

The first large vessel to be constructed in Japan was the "Tsukuba," an armored cruiser of 13,750 tons. Begun in January, 1905, she was launched in the following November and completed in December, 1906, having thus taken less than two years to build—a very notable achievement. In March, 1912, we find Japan laying the keel of what was then the largest and most powerful battleship ever designed. This ship, the "Fu-so," still led the world in respect of dimensions when she was completed in 1915, just as the later "Nagato," commissioned in December, 1920, remains the heaviest battleship—as distinct from battle cruisers—which has been completed to date. By comparison with this rapid development of an industry that barely existed a generation ago the growth of German shipbuilding, which used to be considered very remarkable, was a slow and laborious process. There are now half a dozen shipyards in Japan which could, if necessary, build warships of the largest dimensions. Given the necessary funds and an adequate supply of material, Japan would therefore be in a position to reinforce her navy on a far larger scale than she has done up to now. But the present program is already straining her finances to the utmost, and it is very improbable that she will go beyond the "eight-eight" scheme, even though the Conference at Washington should prove abortive in regard to the restriction of armaments.

Battleship "Ise," also "Hiuga." *Displacement,* 31,260 tons. *Speed,* 23 knots. *Armament,* Twelve 14-in.; twenty 5.5-in.; six torpedo tubes

Japan at the present moment is by no means so strong in capital ships as seems to be popularly assumed. Her dreadnought battle squadron comprises only seven ships—"Settsu," "Fu-so," "Yamashiro," "Ise," "Hiuga," "Nagato," and "Mutsu"—and it is doubtful whether the "Settsu," armed only with 12-inch guns, can be considered a first-class unit. The six remaining ships are, however, equal in gun-power to any vessels afloat, and the "Nagato" and "Mutsu" remain for the time being the strongest representatives of their type in any of the world's fleets. The only other all-big-gun ships are the four battle cruisers "Kongo" "Hi-yei," "Haruna," and "Kirishima." Powerful though they be, these ships date from the pre-Jutland era, and are especially deficient in protection. They will lapse into obsolescence as soon as the new type of battle cruiser now under design or construction in the United States, Great Britain, and Japan comes into service. It will be seen, therefore, that the Japanese Navy of today includes only eleven ships of the dreadnought type, and nearly half of these are, or shortly will be, of problematical fighting value. The real significance of Japan's naval policy lies not in the size of her existing fleet, but in the scope of her new program, which passed the Imperial Diet in July, 1920. This measure covered appropriations for no fewer than fourteen new capital ships, viz., six battleships and eight battle cruisers, all of which are to be completed in 1927. Four of the ships included therein are now on the stocks, leaving ten to be commenced between now and 1924 if the stipulated dates of completion are to be adhered to. The Japanese naval authorities are maintaining impenetrable secrecy as to the characteristics of all these vessels, but since they will be of considerably later design than any warship now constructing in the United States or elsewhere, they may possibly prove to be unique in size and gun-power. If no new American construction is authorized in the interval, the completion of the "eight-eight" program will put Japan on an equality as regards post-Jutland ships. In cruising vessels she will enjoy an absolute superiority. Ten light cruisers of 25 knots and over have been completed, four are building, and twelve more have been authorized, giving a grand total of twenty-six. Provision has been made also for an eventual establishment of at least 100 destroyers and from 110 to 120 submarines. The completion of this vast program will tax the Japanese shipbuilding, engineering, and armament industries to the utmost, and it yet remains to be seen whether they are competent to under-



Battleship "Yamashiro;" also "Fuso." *Displacement,* 30,600 tons. *Speed,* 22.5 knots. *Armament,* Twelve 14-in.; sixteen 6-in.; six torpedo tubes

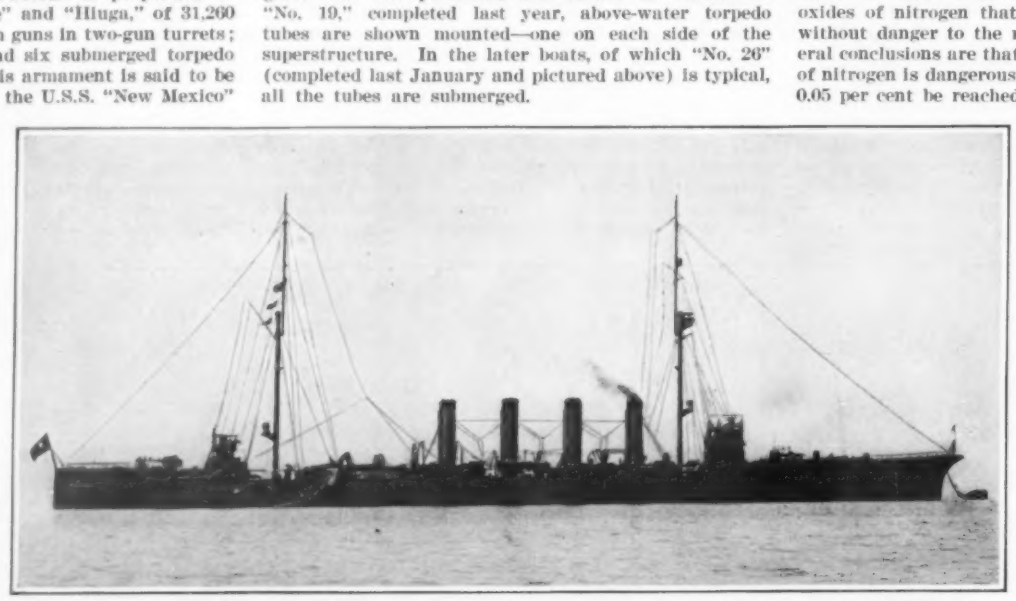
take and complete so much work during the next six years.

Although no official figures have ever been published, it is well known that shipbuilding in Japan is very expensive. The battleships "Nagato" and "Mutsu," of 33,800 tons, are said to have cost $35,000,000 apiece. Taking $40,000,000 as a very conservative average for the fourteen capital ships yet to be completed, the building of these vessels alone will involve Japan in an expenditure of $560,000,000; and to this must be added the cost of all the new light cruisers, destroyers, submarines, and auxiliaries. No wonder that the Japanese naval budget, which already swallows up 35 per cent of the total revenue, is expected to absorb as much as 40 per cent a few years hence.

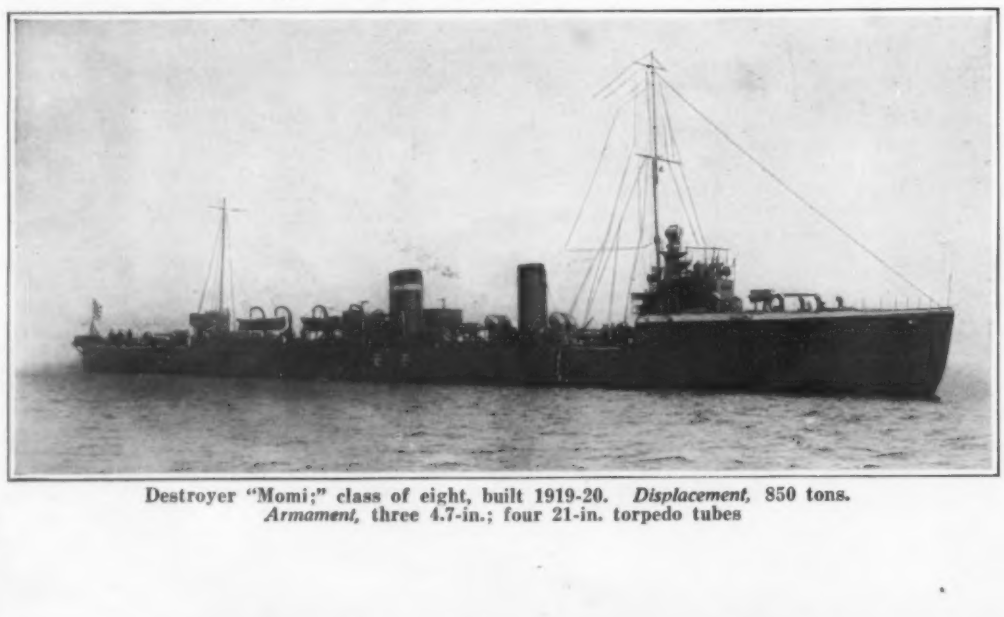
Submarine "No. 26." Class of eight built 1917 to 1921. *Displacement,* surface, 800 tons; submerged, 1100 tons. Details not available; believed to be generally similar to our own 800-ton boats

Warship construction in Japan has hitherto developed along fairly original lines. The latest battleships have an armament remarkably powerful in proportion to their displacement. The "Ise" and "Hiuga," of 31,260 tons, each carry twelve 14-inch guns in two-gun turrets; twenty 5.5-inch R.F. guns, and six submerged torpedo tubes. The total weight of this armament is said to be 18 per cent more than that of the U.S.S. "New Mexico" (32,000 tons), whose twelve 14-inch guns are in triple turrets, while her secondary battery is very much lighter, and her torpedo equipment limited to two tubes. Moreover, the "Ise" and "Hiuga" are 23-knot ships. On the other hand, their armor protection is light compared with that of American contemporaries. The "Nagato" and "Mutsu" superficially resemble the U.S.S. "Maryland" class, but they are 1200 tons larger and two knots faster. The "Kaga" and "Tosa," laid down last year, are battleships of 39,000 tons, with a main armament of ten or twelve 16-inch guns. The battle cruisers "Amagi" and "Akagi," begun this year and due to be launched in the coming spring, displace about 43,000 tons, with a main battery of eight 16-inch guns, a 12-inch armor belt, and a designed speed of 33 knots. They will consequently be faster and more heavily armed than the "Hood." Two further battle cruisers, "Atago" and "Takao," which are to be laid down next January or February, will represent an improved type, and may be the first ships in the world to carry a battery of 18-inch guns. It is evident from the public speeches of her Minister of Marine that Japan does not mean to be left behind in the race for speed and gunnery supremacy. An experimental 18-inch gun of 45 calibers was completed at the Muroran Iron Works last spring, the breech mechanism having been made at Kure. The data regarding this gun are not available.

Japanese designers almost invariably aim at concentrating the maximum degree of fighting power in each vessel, whether battleship, cruiser, or destroyer. They are reported to have worked out some very novel plans for the new light cruisers, in which a sea speed of 33½ knots is to be combined with a battery of 8-inch guns. Their latest destroyers of the first class are also larger and more heavily gunned than foreign ships of corresponding date. Very little is known about the Japanese submarines. Some years ago the foreign designs from which Japanese constructors had been working were discarded, and plans prepared of a submarine more adapted to the special conditions in which under-water craft operating in the Far East have to navigate. The experiment does not appear to have been a conspicuous success, for according to recent reports the native constructors have now adopted a design based upon that of the surrendered German U-boats. Among the submarines building in Japan are several very large boats, of 2000 tons or more, with an extensive cruising range and equipped with mine-laying gear. In the published illustration of Submarine "No. 19," completed last year, above-water torpedo tubes are shown mounted—one on each side of the superstructure. In the later boats, of which "No. 26" (completed last January and pictured above) is typical, all the tubes are submerged.



Scout cruiser "Hirado;" also "Yahagi" and "Chikuma." *Displacement,* 4950 tons. *Speed,* 26 knots. *Armament,* Eight 6-in.; three torpedo tubes



Destroyer "Momi;" class of eight, built 1919-20. *Displacement,* 850 tons. *Armament,* three 4.7-in.; four 21-in. torpedo tubes

The Determination of Oxides of Nitrogen

THE Bureau of Mines, in the course of its work looking toward the minimizing of accidents in mining operations, has occasion to make analyses of gases in determining the ventilation conditions and the hazards that may develop from exposure of the workers to gases liberated in mines. Not only is it important to identify such gases as form explosive mixtures and are at times liberated in large quantities, but in addition it is necessary to determine what gases have harmful effects upon miners who are exposed to them while at work. In metal mines where much blasting is done, the shots are often prepared improperly, and some oxides of nitrogen may be formed after firing. Moreover, other industries than mining produce oxides of nitrogen which have a deleterious effect on individuals breathing them for any length of time.

Two gases that result from the firing of explosives are, because of their physiological effects, important in mine ventilation. They are carbon monoxide and oxides of nitrogen. Other gases produced at the same time, including carbon dioxide, hydrogen, methane, and nitrogen, are unimportant unless in proportions sufficient to diminish appreciably the oxygen content of the mine air. Carbon monoxide and oxides of nitrogen usually occur together and are very harmful, even when inhaled in small quantities. About 0.01 or 0.02 per cent is the maximum quantity of carbon monoxide allowable continuously in mine air without affecting the workmen harmfully, although as much as 0.04 per cent is harmless for periods of time not exceeding one hour. Very little data are available on the maximum quantity of oxides of nitrogen that may be tolerated in mine air without danger to the men working therein. The general conclusions are that 0.01 and 0.02 per cent of oxides of nitrogen is dangerous and under no conditions should 0.05 per cent be reached. Carbon monoxide can be determined to an accuracy about 0.02 per cent by the usual Haldane analysis, but an accurate method of determining oxides of nitrogen at low concentrations has heretofore been impossible without using a large quantity of gas for a sample.

A method was desired by which very small quantities of oxides of nitrogen could be determined from a minimum quantity of gas, for samples of mine gases are taken most conveniently in vacuum bottles of about 250 c.c. capacity. The nitrom method used by Gutbier and Busch is difficult to perform and can not be used at such low concentrations as are present in the usual mine-air samples. To be of value in mine-gas analysis, a method should be accurate to at least 10 parts per million, or 0.001 per cent. After explosives have been fired, especially in ventilated working faces, the products of the explosion are, of course, diluted with large quantities of air, and the amounts of oxides of nitrogen present will usually be lower than 100 parts per million (0.01 per cent). To determine these small quantities, a method was adapted from the usual procedure for the determination of the oxides of nitrogen in water analysis, applying the di-phenyl sulfonic acid method to give the total oxides of nitrogen as nitrogen peroxide or as nitrates. By the use of the method evolved, 10 parts of oxides of nitrogen as nitrate could be detected in one million parts of the air oxides of nitrogen mixture with an accuracy of five or six parts per million.

New Argentine Floating Dock

THE great variation in the height of the Parana River at different seasons of the year and the cost of keeping the port dredged of the quantities of mud brought down caused the Public Works Department to favor floating docks for the smaller river ports, such as Bella Vista, Corrientes.

A cross-section plan of the new floating dock at Bella Vista may be of interest to American construction companies, as it is typical of all those to be built on the Parana River. The plan may be consulted in the Latin American Division.

Recent Advances in Lighting

The Modern Illuminating Engineer: Artist, Electrician, Chemist and Psychologist

By M. Luckiesh

Director of Applied Science, Nela Research Laboratory

DURING the past few years the Great War has had some influence upon lighting progress. Developments along certain lines were necessarily curtailed, for the facilities of laboratories were generally concentrated upon war-time problems. There were many developments such as signal lamps, searchlights, and other special devices which have less extensive applications in peace time, although normal activities will profit by them. One of the greatest benefits that lighting received from the war was a greater appreciation of the value of adequate and proper lighting in increasing production.

In a brief consideration of recent progress in lighting the electric incandescent filament lamp still demands chief attention. The luminous efficiency of this type of light-source increases very rapidly with increase in the temperature of the filament and until the limit is reached there will be a diligent search for new filament material or for ways in which older materials can be operated at a higher temperature with satisfactory life. No new filament material has been used in this type of light-source since the practical development of the tungsten filament; however, by developing ductile tungsten it was possible to wind the filament into a very small helix with great practical results. The filament now possessed, in effect, a relatively much larger diameter which made it possible to operate at a much higher temperature by immersing it in an inert gas; and the resultant gain in luminous efficiency outweighed the loss due to the cooling by the gas. The increase in efficiency was due to the fact that the greatly reduced evaporation of the filament permitted a large increase in the filament-temperature. Thus with the same filament material the luminous efficiency of the tungsten lamp has been greatly increased in the past decade.

It is interesting to note that the output of carbon-filament lamps in this country decreased in 1920 to only 4.3 per cent of the total number of lamps made as compared with 7 per cent in 1919 and 97 per cent in 1907. This lamp is now practically extinct in general lighting. However, great possibilities are inherent in the carbon filament because carbon melts at a very much higher temperature than the metallic filaments which have replaced it. It will not be surprising to find carbon return some day to its old importance in light-production.

Even after the great step had been made from vacuum to gas-filled tungsten lamps many minor improvements have extended the fields and satisfactoriness of the tungsten lamp. By increasing the efficiency and providing a special dense blue glass the tungsten lamp has invaded the portrait studio. By a similar procedure an approximation of average daylight has resulted which makes this kind of artificial light more satisfactory where daylight quality is best. Diffusing glass and coatings have been developed to reduce the glare from bare filaments. Other developments pertaining to colored bulbs, coatings and accessories are extending the applications of light in signs, theaters and elsewhere. By improvements in construction of filaments and by the adoption of a hard glass for bulbs the electric-filament lamp is now widely used for projecting moving-pictures and lantern slides. Another conspicuous improvement has been made in the gas-filled lamp for automobile headlights. Careful attention is given to the position of the filament and to its concentration, thereby increasing the accuracy of focusing. Extensive applications of the tungsten filament lamp have been made in a variety of projection apparatus. The highest temperature of the tungsten filament found in commercial lamps of to-day is about 3300 degrees. This is obtained in 900-watt tungsten filament lamps developed for projecting moving-pictures. This filament operates at 0.46 watts per spherical candle-power.

Incidentally electric filament lamps are now being rated in terms of lumens per watt instead of watts per candle. This is a great advantage because the total output of light can be determined by multiplying the watts by the luminous efficiency. The older method of watts per candle did not afford a measure of the total output of light because the intensity was usually given in a single direction or as an average in a certain plane. This new method makes it much simpler to solve illumination problems because when the output of the light-sources is known it is only necessary to provide certain factors which represent the efficiency of the lighting unit and the utilization-factor for certain combinations of systems of lighting and of reflection-factors of surroundings.

The arc-lamp has practically disappeared from interior lighting, and with the exception of the magnetite arc is decreasing outdoors. The magnetite arc is now used in some places for high-intensity lighting in the more congested portions of cities. The arc-lamp of various special designs has gained ground in moving-picture studios. The Beck arc-lamp and modifications of it have greatly increased the beam candle-power of the large searchlights. In this type carbons are relatively small and a blast of alcohol vapor or of air is directed upon the arc. This makes it possible to obtain a very small source of light of extremely high brilliancy. These two factors are necessary for obtaining powerful beams of light by means of parabolic reflectors. The largest searchlight reflectors developed during the war were five feet in diameter. In recent years special flame carbons have been developed so that the arc-lamp has found some further applications in photography, dye-testing, and other photo-chemical processes.

The low candle-power neon vapor lamp has been introduced in England. In principle these are vacuum tubes, although the bulbs are generally spherical. The candle-power is relatively low for the 110-volt lamps. One neon lamp made in Germany is designed for use with alternating current at one ampere and 220 volts. In order to strike the arc a vacuum interrupter is connected in parallel with the lamp, a small choking coil being inserted in the common portion of the circuit. An inductive impulse set up by the automatic action of the interrupter by means of a magnetic coil causes a discharge through the lamp. This lamp is claimed to operate at 0.5 watt per candle-power, and can be started and stopped as often as 400 times a minute. The resistance of such lamps as determined by voltage and current is not fixed, but varies with the intensity of the discharge. A lamp for 20 milliamperes direct current has about 10,000 ohms resistance. In general, a consumption of 4 or 5 watts is sufficient for many purposes. Quite a variety of these lamps has been placed on the market in Europe. Although this type of lamp is not yet of sufficiently high candle-power to be used for general lighting, its use has been suggested for signs, for emergency lighting, in parallel with a fuse to detect and show burnout, as a position indicator for switches, as a distant indicator of the condition of a motor, and for many other purposes.

Only the usual incidental improvements have been made in recent years on the mercury-vapor arcs. These have not been such as to open new fields for this lamp. The introduction of the quartz tube made it possible to obtain higher luminous efficiency because the quartz withstood the higher temperatures of higher current densities. It has been difficult to seal the leading-in wires into the quartz, but recently a method of connecting quartz through intermediate steps of glasses has been developed which makes better seals.

Minor improvements have been made in gas-burners in recent years. Very little gas-lighting is entering new residence districts in this country as compared with electric lighting. Owing to economies forced upon different countries by the war there have been some gains and some losses in gas-lighting. Owing to the oil shortage some time ago, and to other causes, there was a tendency for some gas companies to produce gas of lower illuminating value. This led to the elimination of many open burners and to the substitution of mantles. It is surprising that in this age of adequate lighting so many open gas-flames were found. In recent years high-pressure gas-lighting has made some headway, and considerable progress has been made in automatic gas-lighters and extinguishers and in the development of fixtures. Considering the greater difficulties inherent in the gas-burner the developments in gas-fixtures are worthy of commendation.

As an example of the changes due to necessity may be mentioned the revival of the old lime-light in Germany. In that country, temporary restrictions having been placed upon the use of electricity, the lime-light has been used to some extent for cinema projection. The button of lime has been replaced by a disk of rare earths which is heated by an oxygen-acetylene flame. The acetylene is produced from calcium carbide and the oxygen by gently heating a patented material sold in small metal tubes enclosed in the ordinary steel bottles.

During the past few years the greatest developments in lighting have been made in the utilization rather than in the production of light. In fact, the interest displayed in proper and adequate illumination before the war increased greatly in such fields as manufacturing during the war. Now in this country the cause of good lighting is again progressing in all its phases. In the industries the tendency is toward higher intensities and toward proper reflectors which shade the lamps. Metal reflectors have been well standardized in design and leading manufacturers of such lighting equipment meet the specifications. For direct lighting it was also necessary in many cases to equip the bowl of the lamp with an opaque or dense diffusing-glass cap in order to eliminate glare from it. To eliminate this accessory, leading lamp manufacturers have placed on the market a bowl-enamelled lamp. This is the first superficial coating to withstand the temperature of the bulb of the gas-filled lamp. In factories where an illumination of one or two foot-candles has been common in the past, it is now not unusual to find intensities ten times as great.

For years lighting was based almost entirely upon the foot-candle intensity on a horizontal working-plane, but with the development of the science and art of lighting various other factors have been given attention. Glare reduces the ability to see, thereby increasing spoilage, decreasing production, and increasing the accidents in the industries. The size, position, and number of light-sources determine the shadow effects which are now known to play a large part in visual discrimination. The lighting expert now studies the work to be illuminated and determines the desirable intensity of illumination, the character and brightness of the background, and also whether or not local light-sources are to be used supplementary to general lighting. However, general lighting of fairly high intensity is the most desirable and general solution. It is now realized that the speed of visual discrimination depends upon the intensity of illumination. It is perhaps due partially to a general stimulation of alertness in the worker as well as to an increased ability to see. The expert also gives attention to the character of the surrounding surfaces, such as walls, desk-tops, etc., for if these are glazed they operate to some degree as

(Concluded on page 78)

WHEN the electric light was first being freely introduced into our homes and offices, it was such a startling contrast to the guttering oil lamp and the feeble open gas flame which had been in general use before it, that the public of the late 90's might well have been pardoned for supposing that the ultimate in artificial lighting had been achieved. But how mistaken they were will appear to the present generation if we will but take one of the good old-fashioned carbon lamps with the simple looped filament—always supposing that we can find one —and attempt to read by it. In the light of present experience with the 50 and 75 and 100 candle-power bulbs that are seen on every lighting fixture of 1921, the "wonderful" 16-candle-power light of 1900 is altogether dim and ineffective; it is surpassed by fully as wide a margin as it in its heyday enjoyed. Unless we have actually made this comparison we are apt not to realize what enormous strides the past decade has seen in the art of illuminating. Mr. Luckiesh, one of our foremost illuminating engineers, tells us in this article of what this advance has consisted and how it has been effected.—THE EDITOR.

Left: Inside view of snowshed on Government railroad in Alaska. *Right:* Susitna River bridge, showing the steel span under construction

Examples of the sort of work called for by railroad building in Alaska

Government Railroad in Alaska Nearing Completion

Connecting Seward, at the Head of Resurrection Bay, with Fairbanks by a 471-Mile Line

THE Government Railroad in Alaska connecting Seward, at the head of Resurrection Bay, with Fairbanks, is now approaching completion. The southern end consists of a line that had already been constructed. But the great part of the total main line of 471 miles, the Government has had to build.

The line on its way to Fairbanks crosses the great Alaskan Range, which is really a northern prolongation of the Rocky Mountain System. There are many streams and valleys to pass on the southern and northern flanks of the mighty ridge. Most of these are, naturally, small streams. After passing Anchorage and Matanuska, which are at the sea level and located, respectively, at distances of 115 and 150 miles north of Seward, the road finally abandons the coast and strikes into the rising country. Naturally, the line seeks a pass through the mountains; but all the same the slopes go on up to noble heights. The highest elevation reached in the Alaskan Range is Mount McKinley, whose cap of eternal snow and ice rises to a height of 20,464 feet. Mount Foraker, a few miles to the southwest, reaches an elevation of 17,100 feet. These great peaks are no great distance from the railroad in all the region where the line itself approaches its pass over and through the Range. They lie to the left as the road proceeds north, with the Chulitna River between them. The railway track follows the Susitna River, clinging to its eastern bank, from a point perhaps fifty miles beyond Matanuska northwards to the place where finally the river is crossed. This point is some 265 miles northward from Seward. The approach to Mounts McKinley and Foraker is here rather close, though the point of greatest nearness is perhaps a few miles further north. Here, where the Susitna is crossed, is one of the principal features of construction.

That is to say, here is a total of a quarter-mile of track carried by bridge and trestlework. The principal section of the supporting structure is a 504-foot through-truss span. The main channel lies below.

While Alaska is undoubtedly a land where water freezes readily, we are not to get the idea that the country is a desolate wild where nothing grows and no one can have any joy in living. This is not at all the case. There is a section on the north—occupying perhaps a third of the total area—where conditions are really forbidding; but the southern two-thirds is suited to habitation and to agriculture. Fairbanks is near the northern limit of this two-thirds. Norway and Sweden have many towns further north. The railway will pretty well cover the full north-and-south breadth of the habitable and cultivable section. Seward may be regarded as an all-year port, though this can hardly be said of Anchorage.

In preparing to design the bridge, it was found worth while to ascertain the high-water marks and also the ice-scorings on trees. In this way, the probable height of the river itself and the still higher level of the ice-jams could be estimated. Naturally, the engineers had to know what to expect and to locate and dimension the various parts of the crossing in accordance with what the winters and springs would probably bring. This work in a new country, especially a new district like Alaska, presents problems of some difficulty in engineering, because the engineer can hardly determine all the facts, and so has to make allowance for the unknown. The quarter-mile of crossing has been divided into seven distinct parts. First, there is, going from the south to the north, 392 feet of approach trestlework. This is succeeded by bridge spans of 70, 121, 504, 121 and 70 feet respectively. Then, on the north side comes a short 28 feet of trestle as the road passes from the river onto the bank. On the right hand side of the bridge, the Susitna approaches from the east; while, on the left, it proceeds in a generally southerly direction to the point where it debouches into Cook Inlet.

There is, naturally, plenty of ice in Alaska, especially in the winter time. And quite a lot comes down the Susitna and passes the site of the bridge. It is said that the ice break-up in the spring occurs before the ice has softened. Great pieces of solid ice swing down the river, jamming themselves into islands, bars and shore as the stream makes its turns. The ice piles up and restrains the river. The water level rises and this results in increased pressure against the ice jams. After a time, the ice may yield and then rush on to get into another jam farther downstream. The question the engineers had to face was what would happen to bridge piers exposed to jams and rushes. They probably gave but little attention to the possibility of using timber piers. Concrete, it seems, was thought hardly certain to be equal to the job of withstanding perfectly the scouring action of an ice-jam against the pier. Such action would not be confined to points above the water but to points perhaps all the way down to river bottom. However, concrete piers were decided upon. By making them massive enough, they may be made equal to anything. Two spans for the main channel of 250 feet each were considered in competition with a single 504-foot span. The former would have required not only three piers, but one would have been near the center. Moreover, the cost was slightly less for the single span. This is an all-steel structure, and was completed in February, 1921. That is, the span was swung on the 2nd of that month and a train passed over on the 6th.

But the whole bridge has not been constructed of steel. Timber has been used on all approach spans. However, the main piers have been designed to sustain 200-foot steel flanking piers, the idea being that in the future such piers could be installed in place of the two combinations of a 121- and a 70-foot span of timber. The reason for the use of timber for truss spans was the high price of bridge steel at the time.

In designing such a bridge, the engineers must take into account the effects of the wind on the bridge and also on a train on the bridge. The stresses on parts of the bridge and on the piers themselves will be modified by a wind blowing against train and bridge. Such wind pressures as 40 pounds per square foot of exposed area are taken into consideration.

It has now become approved practice for engineers to test soil and rock on which supporting structures like bridge piers must rest. This is done before, and sometimes continued during, actual construction. It enables the engineers to know in advance what is to be expected. A site thought to be very favorable for a pier might, upon carrying out a series of test borings, be found quite unsuitable. Borings cost a considerable amount, but they give a certain guarantee against disagreeable and costly surprises that is deemed worth the price. Test borings put down 60 and 70 feet here in the bed of the Susitna River showed that the underlying strata consisted of compact sand, gravel and big boulders. The situation was judged of such a kind that the sinking of piles beneath the foundation layers of the piers would be unnecessary.

Track construction had not yet reached the site of the bridge, but was still a score of miles to the south when, on May 22, 1920, the work on the piers was started. This was too early in the year to permit supplies to be brought over the interval by boat, so for a time dependence was put upon sleds. When the river at last was free of ice, boats were employed over the

Constructing the snowshed: the bents are bolted together on the ground and hoisted in place with a crane

water route (the Susitna itself) and wagons on the land. By September, however, the advancing track reached the immediate vicinity of the crossing, and transportation troubles sank to a minimum. The south pier had then been finished and the north pier was begun.

Some hundred feet downstream, a temporary trestle was put across the river and track laid on it. This permitted the movement of freight not only to the south side of the river, but to the north side as well. So, then, while pier construction was going on, the track was pushed on north.

Difficulties are often encountered in excavating for the foundations of large piers. The layers of earth are apt to be permeated with water under pressure and even the rock may contain fissures filled with water under a head. Besides, the river itself may flow over the pier site. There are a number of methods of attacking the problem. Sometimes a wall is constructed all round the site or so as to connect with the shore upstream and downstream and thus effect an inclosure of the spot. This inclosing cofferdam is made more or less watertight and the contained water pumped out. By the use of pumps to keep the water entering through leaks and the like from giving trouble, the excavation is carried on and the pier constructed. This is a method of dry construction. It was employed in connection with the south pier. The wall consisted of Wakefield piles. These, when suitably driven, create a wooden diaphragm everywhere interlocked. The Wakefield pile seems to be an American invention dating back many years. A typical unit may be made by spiking three planks of equal width together. The outer planks are set exactly opposite each other, but the center one is displaced perhaps two or three inches, though kept parallel. The unit will then have a tongue on one edge and a groove of identical size on the other. By driving such units one after the other, with the tongue of the new pile in the groove of the pile last driven, a continuous wall may be created that is already more or less watertight. It is a very useful device, and has been in considerable use in the past. The interlocking steel sheet pile is now perhaps driving it out of service. The steel substitute can be made tighter and can be driven to much greater advantage because of its superior strength and the knife-like edge on the bottom. However, the engineers used the Wakefield pile at this crossing in Alaska, possibly because timber was near and relatively cheap. On the other hand, steel sheet piles may usually be pulled out and used again and again; so that the actual expense on one job is much reduced by the salvage value.

In concreting the piers, difficulty was experienced from more than one direction. Often, engineers seek to get the small rock used in concrete from some nearby gravel bank. Sometimes, the relative amount of intermingled sand is just what is wanted for the concrete mixture. If there is no foreign matter present—that is, nothing but bare sand and bare pebbles—then the gravel-bank is a kind of treasure. At the bridge site, there was a gravel bank, with intermingled sand, though the sand was deficient in amount. This was naturally something that could be corrected. Nevertheless, there occurred a partial failure of one of the piers during construction. The failure was due in part, it appears, to the presence of humus on and among the pebbles.

The strength of concrete depends upon the cohesion of the constituent particles. Sand particles, cement particles, and pebbles, in themselves, are likely to have satisfactory cohesion; but where the joints among these occur are locations of possible weakness. The cement constitutes the only binding agent. It should cover the entire surfaces of sand particles and pebbles. Where it is absent, there a weak spot will occur. Loam, humus, or any material weak itself in cohesion would

Rebuilding French homes with bricks of slag made on the spot

be an injurious ingredient. Pockets and films of such material break up the continuity of the cohesion and thus tend to destroy the strength. At any rate, the partial failure in one of the piers was attributed to poor cement, humus and low temperature.

The cofferdam was unwatered, which automatically put the bottom, consisting of porous material, under a 22-foot head of water. Apart from friction, this meant an upward pressure over the bottom of 9½ pounds per square inch. It was found to be practically impossible to partition off the space and place concrete against the pressure. In November, the water was almost to the freezing point and the area to be covered was large. To use piping or buckets and place the concrete under water seemed out of the question. It was, accordingly, determined to deal in a special way with the conditions. That is, the space was housed in and, by means of steam coils, made warm. Even the sand and gravel were heated on platforms beneath which coils were placed; and the water for mixing the concrete was also heated. Concrete was put in place under these conditions during a period when the outside air varied from 2 deg. below zero to 48 deg. above. At the north pier the temperature conditions were still more unfavorable, the readings varying from 12 deg. below to 34 deg. above.

That Alaska is not necessarily an impossible place to live and work in during the winter may be illustrated from the fact that the 504-foot span was erected and swung in the period November 8, 1920—February 6, 1921. Riveting on one day was done when in the morning the temperature was 42 deg. below zero and 12 deg. below at quitting time. It is said that rivets driven during very severe weather were given a retesting a number of times later on when the weather became warmer. The timber work was all completed by February 16, 1921, and the whole made ready by that time for regular service.

It will be gathered perhaps from the foregoing that the Government is pushing its railroad on, seeing that winter did not interrupt work high up near the pass through the mountains. In fact, as it is stated under date of August 26, 1921, through traffic is now established from Seward, the southern tidewater terminal, to Hurricane Gulch at mile 284. Also, the branch line from Matanuska is now open to Chickaloon. There is still a gap on the main line between Hurricane Gulch and Healy—that is between miles 284 and 358. It is hoped to close up this gap of 74 miles by spring, 1922. A steel arch which is to carry the line across Hurricane Gulch was already well advanced toward completion at the August date given. From mile 358 to Fairbanks, the road is completed with the exception of a long steel bridge which is to cross the Tanana River at Nenana (mile 411). In fact, this northern part of the main line is already in service, the passage over the Tanana River being made by ferry. In short, by the summer of 1922, it will probably be possible to travel over the entire line from Seward to Fairbanks, with the possible necessity of using a ferry at the Tanana River.

The proper term to use in connection with the entire line, including its branches, is the Government Railroad in Alaska.

Home-Made Bricks in Devastated France

FOR the construction of houses in the devastated region of France, a material is required which shall give high economy. In high present favor at the moment for this purpose is the agglomerate brick made on the spot. Slags and metal dross of all sorts are available, and with any of these substances it is possible to make admirable bricks with the aid of heat. These materials are common enough, and are employed very largely in the manner shown; our photograph indicates the simplicity of the manufacture of this sort of brick.

The prerequisites are a semi-plastic mortar of the proper proportions, the slag and a source of heat. Then the mixture is introduced into the mold, in several installments, the pestle meanwhile being gently operated to pack the material well against the walls of the mold and insure properly formed sides, edges and corners in the finished brick. Once the mold is filled and well packed, the upper surface is evened off by scraping with a flat board. Then the brick is left to set, and is ready in a few hours to be removed from the mold. After removal, the brick is left in the open air until drying is completed, after which it is put in its final place in the wall without further ceremony. The houses constructed in this unusual fashion are reported to be standing up very well in use.

Track Laid on Cables While Fill is Beipg Made

UNIQUE construction methods were found necessary in building the "toes" to the Taylorville Dam as part of the flood prevention work of the Miami Conservancy District. Instead of spending considerable time and money in building a trestle to carry the tracks, it was decided to suspend the tracks on heavy wire rope. The river surface was about 20 feet below the high bank from which it was necessary to run the trains out. At the beginning of the work there was almost 10 feet of water in the river and 15 feet of mud before striking the gravel foundation.

Four lengths of cables were used, each being 582 feet long. The two inner cables were placed three feet apart, the two outer cables 12 feet apart. Ties were placed on these cables, each third tie being long enough to catch the outer cables. The tracks were then laid on the ties. Each cable was fitted with special bridge socket and take-up for adjustment. The equipment was in use about one month, and during that time the take-up of the cable did not exceed 15 inches.

Great care was taken in backing the loaded trains out on to the suspended track. As soon as a loaded car reached the edge of the embankment, it was dumped and then pushed on empty. This plan kept any excessive weight off of the suspended structure. The rock thus dumped displaced the mud and shut off the flow of water before the fill was half across the river.

The cables stood the work so well that after the job was finished they were put to use as swinging cables on steam shovels.

In making this fill, the expense of a trestle was saved by running the tracks across on a pair of suspended cables

Noises for the Movies

How Various Realistic Sounds Are Produced by Means of Ingenious Drummer's Traps

By Albert A. Hopkins

IN Verdi's celebrated "Anvil Chorus," we have an imitation of the auditory effects produced by the blacksmith when he hammers on his anvil. When appropriate standard instruments are used, many will doubtless have no difficulty in imagining that they hear the hammer strike. The composer, however, was limited by the fact that other things had to be cared for besides giving a suggestion of realism to his music. Among the traps of the drum section of an orchestra is a little instrument which may be used to deal with the matter of imitation with a still closer approach to reality. This is the "anvil," and it consists of two parallel steel tubes of unequal length mounted on a small base. The tubes are 1⅝ inches in diameter, and give two notes, one from each tube. Here the true anvil is imitated by an instrument of substantially the same material as the thing imitated. The form, though, is quite different.

How to imitate, simply and effectively, the many sounds suggested by activities represented in motion picture presentations, is a matter of interest. The exhibitor knows that, if the vision of the prowling lion can be accompanied at critical moments with a realistic roar or two, the audience will be much better entertained and thrilled than if the picture were allowed to pass silently. The heroine is held by her enemies, but the rescuing hero is fast approaching on horseback. If the regular thud, thud, of the coming horse can be rendered true to reality, then an added satisfaction will be given to what the eye sees. Such audible accompaniments have been successfully used upon the regular stage, so one need not wonder that moving picture people are following this lead. In fact, we may expect a greater development of the imitation of sounds on behalf of the "movies," because such sounds are urgently needed to intensify the effects produced by the pictures.

The imitation of definite sounds—musical notes—may be put upon a scientific basis. In the nineteenth century, prolonged investigation showed very conclusively that the *quality* of a sound, as distinguished from its pitch and intensity, is dependent upon the combination of simple sounds which go to make up a composite effect. A simple sound may be defined as one which can not be divided into others. It may be said to have no especial quality. The sound produced by the tuning fork may be classed as simple. Perhaps a musician specially trained may be able to detect in an ordinary musical note not only a predominant pitch, but one or more subordinate ones. Ordinary people hear the note as a unit. Nevertheless, ordinary people distinguish quality.

A cornet sounds B-flat in the octave above middle C. The ordinary person has, perhaps, no difficulty in distinguishing the quality of the note from the note of the same pitch made by the violin. There are, in both cases, subordinate notes which sound simultaneously with the B-flat. The quality of the composite tone will depend upon what these others are. Perhaps the musician specially trained may succeed in naming them; the ordinary person would certainly fail. But, it is possible to approach the matter differently; and give the ordinary listener a better opportunity. If, indeed, the generality of musical sounds are composites made up of combinations of simple ones, then it should be possible to synthesize simple sounds and get the composite effect. The B-flat on the cornet should be producible by a proper assemblage of simple sounds of various pitches and perhaps of various intensities. This is just about what modern science claims.

With so many sounds desired by the movies, it would be impracticable to produce the imitations in this way. Greater simplicity is required. This is especially the case where the sound is not only composite at a given moment but variable from moment to moment. Advantage is accordingly taken of the circumstance that it is often possible to find a natural material which will produce when vibrated the composition of simple sounds desired. In some cases, the variation required in a prolonged and varying note or series of notes may be obtainable by manipulation of a source of sound. But these methods of utilizing various sound-producing materials, while very valuable at times, do not always quite equal requirements. There is something defective here and there in the imitation. The scientific method of putting sounds together might be called in at this point and made to perform the service of determining just what is lacking or just what is overdone. The procedure might be somewhat as follows:

The instrument used to produce the lion's roar may, perhaps, not quite do the trick at some portion of the rendition. The problem here may probably be solved by determining just what combinations of pitches and intensities produce, at this juncture, the perfect roar of the real lion. These could then be tabulated. Next, a determination would be made of the exact components of the defective sound, and these listed. A comparison of the two statements would then disclose the fault, and possibly suggest its correction. If something additional is needed—say, a simple sound of such and such pitch—it may be supplied. If, however, the imitating sound contains too much, the problem would seem more difficult to solve. What I am suggesting is a scientific method of determining why an imitation is not quite successful. The whole sound may be built up by providing the proper composite of simple sounds; or, sometimes more easily, by assembling together smaller groups. If the variations from instant to instant are not difficult to manage, the whole sound—as, perhaps, a lion's roar—may be rendered with some fidelity. Thus, if the lion's roar were scientifically investigated and its components precisely determined and set down, one might perhaps see at once that certain notes of a pipe organ would give a very good rendition. Or, the simultaneous utterance of a certain note by this instrument of the orchestra, another certain note by that instrument, and so on.

However, the business of supplying instruments which may be used as sources of imitative sounds has been developing. The tubular substitute for the anvil has already been mentioned. A metallic sound is here imitated by a metallic sound produced by a similar metal. The lion's roar is produced by an instrument on the market. This consists of a shell closed at one end and open at the other. Several hoops surround the shell, one of them securing the diaphragm closing the one end. This diaphragm is a membranous affair. It is set in motion by a string through the center. The shell is considerably smaller than an ordinary wooden water bucket. A smaller but somewhat similar affair produces a sound imitative of a dog's bark.

Note now this: These animal cries are produced by the vibration of animal material similarly to the anvil sounds by the metal tubes. Our previous discussion prepares us to understand what is probably a basic fact here. The tones and overtones of which the animal membrane is capable are doubtless similar to those which make up the lion's roar and the dog's bark. All that is needed may be the shells to inclose a body of air that may be set in vibration. A small affair of a similar character, but with the string passed in and out again through two holes near the middle of the diaphragm to form a closed loop, constitutes an instrument with which the locust or the frog may be imitated. A stick is passed through the loop and the shell whirled round. A steamboat whistle is reproduced by using a kind of triple whistle with the parts differing discordantly from one another. A clog dance may be rendered so far as sound is concerned by operating two long handled mallets as if they were the feet of the dancer. A police rattle is really a kind of rattle. A wooden arm may be whirled round the end of a short handle held in the hand. A tongue of wood is secured near the outer end of the arm and projects back to a cog wheel on the end of the handle. The end of the tongue in passing round the cogs, as the instrument is whirled, produces a strong rattling noise. A steady beat of a horse's hoofs upon a hard and sounding road may be imitated with a pair of cups which are struck, open end to open end. The dull, hollow-like sound gives the *thud thud*. Another instrument imitative of a horse's hoofs consists of two pads or flat cushions which may be struck by two long sticks. A horse galloping over pavement or sod may have his foot falls imitated by strokes delivered on the pads. This same device may be used for a slap in the face, shots made by rifles, or pistols, surf effects, etc. By means of a toothed wheel arranged to turn and let a tongue fall from tooth to tooth as the wheel is rotated, the suggestion is made that a windlass, crane, derrick or the like, is being operated. Here, what we have is a partial duplication of some of the apparatus the sound of whose working is imitated. Another device provided with a tongue permits one to imitate the *click click* of the typewriter or telegraph sender. A self-loading pop-gun enables the operator to imitate the popping of champagne corks.

It will be noted, perhaps, that in some of the foregoing cases the imitative device is really more or less a duplication of the thing imitated. Another example is where an automobile horn is imitated by what is essentially such a horn.

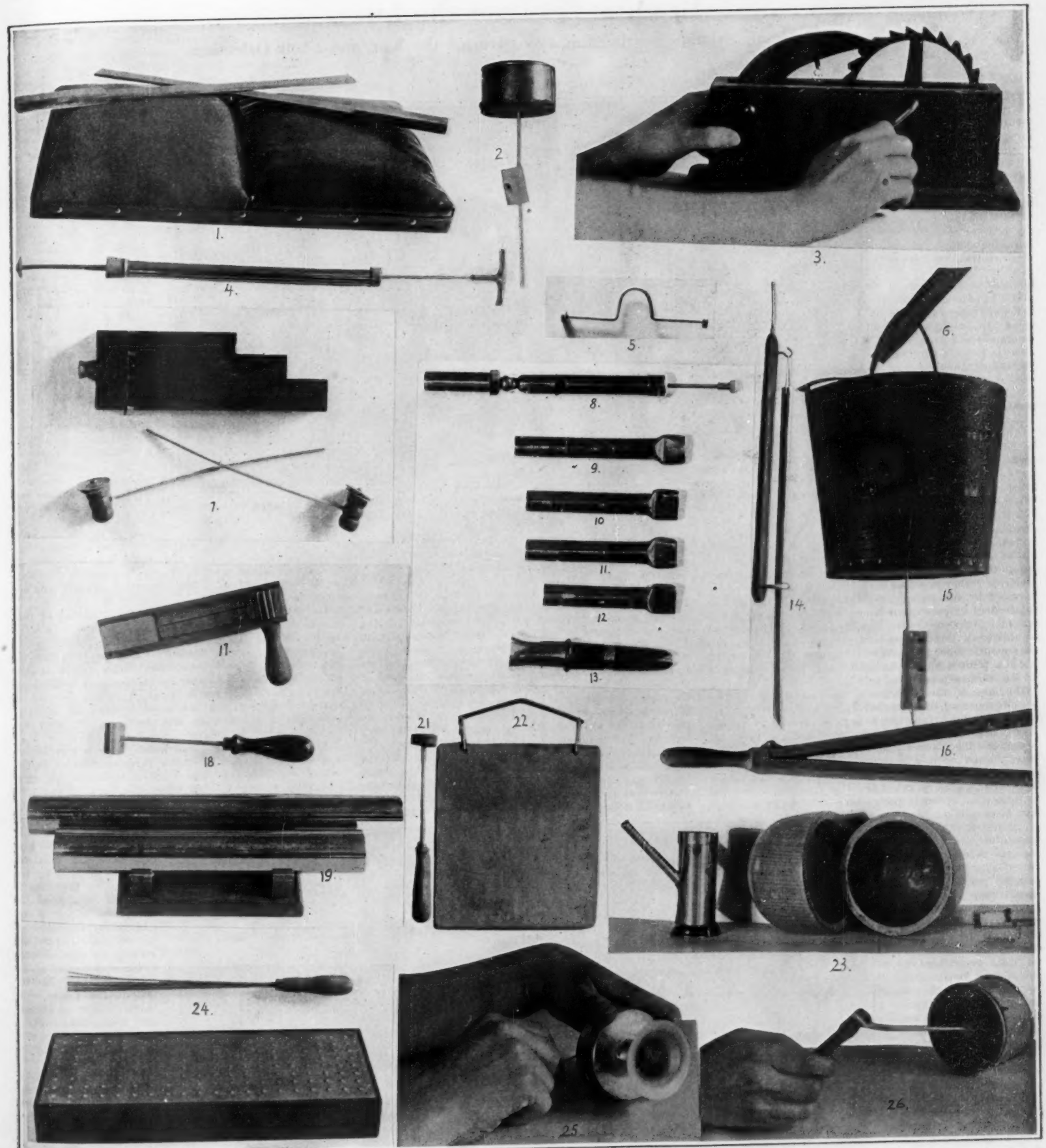
As to the application of such devices as those under review, the moving pictures would seem to offer a wide field that has so far only been entered to a small extent. Apparently, we are still to await a successful combination of the moving-picture machine and the phonograph—the talking movies. At the same time, something less is possible, and that is a well-developed and accurate reproduction of the proper sounds at all points where such sounds would increase the realism of the activities visually represented on the screen. Of course, the thing might be overdone, especially if the sounds are but crudely imitated or are exaggerated too much. A good deal about the movies is already a joke. An addition will not help them. But an adequate, accurate study of the possibilities might tend to break the silence to better effect than the usual rendition of music through the performance.

The phonograph is the great imitator of all kinds of sounds and it might enter into competition with the so-called "drummers' traps." But anything like hanging fire when the sounds are needed would result in ridicule. Piano, organ or orchestral music, if strictly appropriate and reasonably responsive to the changes in mood of the story being depicted, is by no means an ineffectual thing. First rate imitative devices—that is, high-class drummers' traps—used at critical moments provide an additional feature tending to intensify interest.

Large Diesel Engines

THE paper read by Sir James McKechnie before the Engineering Conference of the Institution of Civil Engineers serves to focus attention on the design of large marine Diesel engines of 1,000 b.h.p. per cylinder and upwards. The problem is perhaps not so important as it is sometimes thought to be, for no fewer than 96 per cent of the ships afloat are equipped with machinery of less than 5,500 i.h.p. and a standardized twin-screw Diesel plant of this power is now constructed by many engine-builders. Nevertheless, the question of the production of six-cylinder oil-engines developing 6,000 b.h.p., or even 12,000 b.h.p, will always attract designers, and Sir James McKechnie gave some details of the largest single-cylinder unit that has been built in Great Britain. It was built some time ago at Barrow as an experimental two-stroke model, with a bore of 30 in. and a stroke of 36 in., and under test a power of 1,042 b.h.p. was developed at 141 r.p.m. The fuel consumption was remarkably low, being under 0.40 lb. per b.h.p. hour when using the Vickers system of solid injection. It was a single-piston engine with scavenging valves—a design that would not be considered suitable at the present day for high powers since the opposed piston type and the employment of ports instead of valves have come into general favor.

In this connection it may be noted that by the adoption of opposed pistons much smaller cylinder diameters can be utilized to give the same output; for instance, the 4,000 b.h.p. Camellaird Fullagar engine, with four cylinders, which is now under construction, has a cylinder diameter of only 26 in. and a rotation speed of 90 r.p.m., against 141 r.p.m. of the Vickers engine. It is, indeed, doubtful whether the double-acting two-stroke Diesel engine can be built with smaller cylinder diameters than those of the opposed piston type of equal power, either of the Camellaird Fullagar or Doxford designs. It is worth nothing that the builders of the latter type hope shortly to be able to manufacture their engines to develop 6,000 i.h.p. (or over 5,000 b.h.p.) in four cylinders. In Germany double-acting two-stroke Diesel engines are now being built for installation in mercantile ships developing more than 1,000 b.h.p. per cylinder, so that before long some interesting developments may be anticipated in oil engines for passenger liners.



Courtesy of Mr. H. Gerson

1. Slap pad, which imitates the galloping of horses on sod and pavement, rifle shooting, pistol shooting, slap in the face, and so on, also surf effects and all others that are done with a sand board. 2. The bark of a dog is here produced by jerking the little pad along the string. 3. Turning this toothed wheel produces such sounds as the action of a windlass, crane, derrick, heaving the anchor, and ferryboat entering slip. 4. Self-cocking pop gun, which supplies the "pop" for champagne bottles of the screen. 5. Double hammer for hitting plate shown below at 22. 6. Lion roar or bear growl. 7. Clog mallets with jingles and flexible handles. 8. Whistle of changing notes to imitate certain birds. 9, 10, 11, 12, 13. Whistles of various kinds to imitate barnyard noises and birds. 14. Locomotive bell. 15. Pad which is pulled along rope to operate skin of bucket that produces lion's roar. 16. Slap stick. 17. Rattle for all manner of sounds. 18. Hammer for the anvil. 19, 20, 21, 22. Bell plate and one of the hammers. The other hammer appears above, at 5. 23. Whistle that imitates bird calls, and pair of "cocoanuts", which imitate horse-hoof sounds. 24. Imitation of steam locomotive. 25. "Squawker", which serves for many purposes, such as tearing of cloth. 26. Locust or frog.

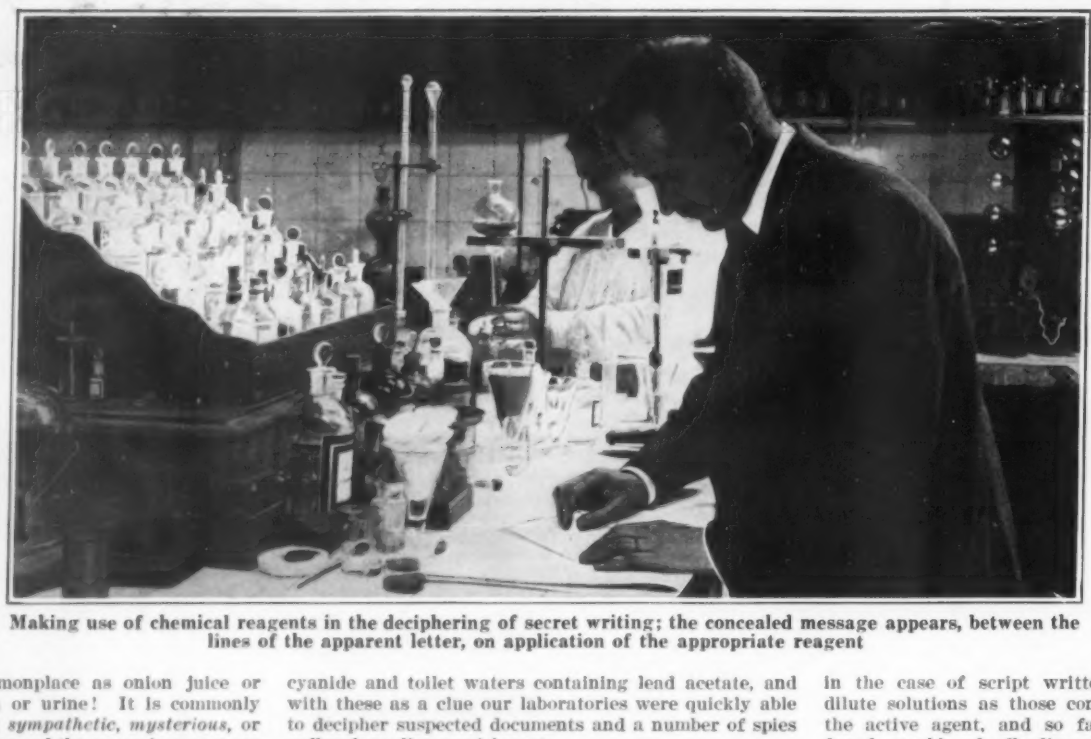
A collection of the leading devices employed by the ingenious trap drummers who supply realistic sounds for our motion pictures

Reading Between the Lines

Methods of Invisible Writing Employed During the War, and Their Detection

By Jacques Boyer

THE art of secret correspondence underwent singular improvement during the war. Correspondingly, too, the chemists connected with the Bureau of Judicial Identity in Paris to whom the study of this subject was confided were obliged to make extensive and assiduous research in order to become acquainted with the astute methods of concealment practiced by German spies. But these French savants went even further by way of foiling the enemy, for they succeeded in devising an absolutely inviolable code for the use of our own spy system.



Making use of chemical reagents in the deciphering of secret writing; the concealed message appears, between the lines of the apparent letter, on application of the appropriate reagent

At the beginning of hostilities our enemies made use of ordinary and well-known inks in writing their despatches. Their agents made use of all sorts of *colorless* liquids—materials as commonplace as onion juice or lemon juice or even saliva or urine! It is commonly known that these so-called *sympathetic, mysterious,* or *magic inks* modify the surface of the paper in a manner which is rather physical than chemical; they are easily revealed by very simple methods—either by placing in dilute dyes or coloring matters, such as ordinary black ink, or by exposure to the vapors of iodine. The method in which all these developers operate is identical, *i.e.*, they attack those portions of the paper which the writing has altered physically with more energy than they do the unaltered portions.

But later on the technique of the German spy system became more scientific in character and the French commissions, whose function it was to censor the mail, found that true *chemical inks* were making their appearance. The secret text upon the documents seized was written with a solution of some chemical salt, either metallic or organic, and protected against iodine and other ordinary developers by the simple method of immersion either in pure water or in water to which had been added a little ammonia or a trace of hyposulfite. Text treated in this manner is affected only by certain definite reagents or a given group of chemical compounds. In order to get at the secret involved in such a piece of writing the expert chemists in charge of the matter must apply in the *proper succession all of the analytic reagents.* But they can obtain the desired result only after lengthy manipulation and at the expense of the neatness of the document. On the whole, however, inks of this sort, composed of liquids having a 10 per cent concentration, offer but precarious protection for secrets. It is perhaps a long road to their unveiling, but it is none the less a sure one. During this period there was discovered in the baggage of suspected German spies soaps containing potassium ferrocyanide and toilet waters containing lead acetate, and with these as a clue our laboratories were quickly able to decipher suspected documents and a number of spies suffered condign punishment.

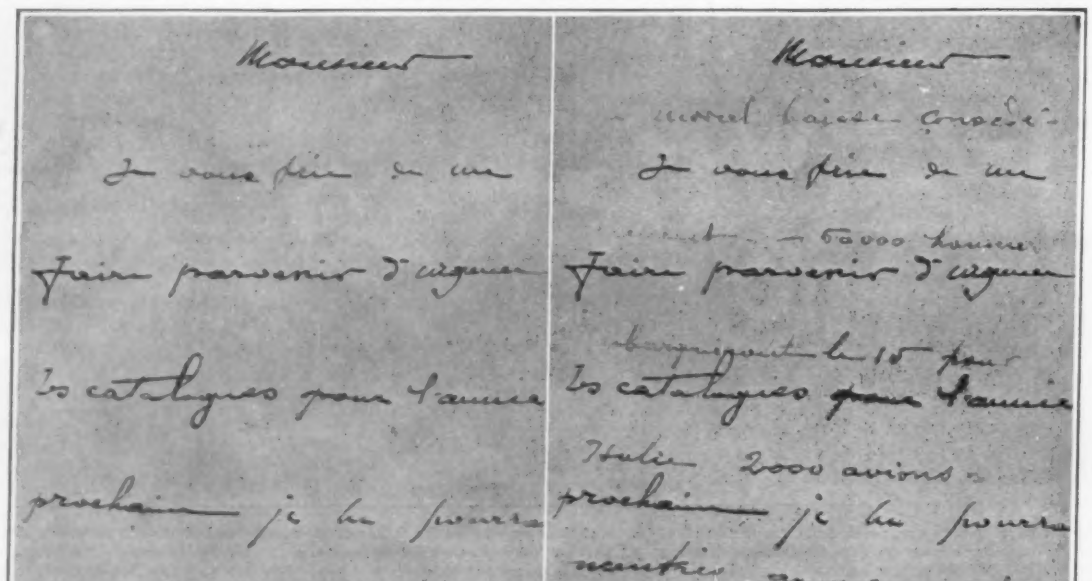
As a result of this the Teutonic technologists made a fresh change in their methods. The liquids designed to be used in secret writing were made extremely dilute, the concentration in some cases being not more than 1/50,000 or even 1/500,000. In the first samples of these new inks which came under our observation was detected the presence of organic compounds of silver of the so-called *protargol* type. Chemical analysis is of no avail with respect to this sort of ink, since the metal is protected from ordinary developers, not merely by reason of its extreme dilution, but also by the very nature of the molecule of which it forms a part.

The German spies hid these inks in their shoestrings or socks, which were impregnated with a very small quantity of the substance in question. A sock, for example, containing only a few milligrams of the active substance needs only to be soaked in a glass of water in order to yield a liquid capable of being used as an invisible ink. The developer capable of revealing texts written in this manner was finally discovered by electrochemical methods.

If infinitesimal invisible traces of certain metals be deposited upon the surface of an insulating material—*e.g.*, a sheet of paper—and if this then be placed in a medium containing a nascent metal, the latter will be deposited by means of electrolysis upon the previously deposited metal traces (which are more or less good conductors), and will render them visible. The easiest type of such a developer to make use of is nascent silver (which is produced when silver nitrate and a reducing agent are placed together). This reagent is effective even in the case of script written with such enormously dilute solutions as those containing only 1/100,000 of the active agent, and so far no substance has been found capable of affording protection against this developer.

But it was not very long after the discovery of this ingenious developer that it became known that in spite of it German agents were conducting secret correspondence across our territory. Just at this time M. Priolet of the Police Department, who was in charge of the Bureau of Counter-Espionage, was notified by his inspectors that the baggage of certain persons of equivocal antecedents contained articles of lingerie, especially handkerchiefs, concerning which they betrayed exaggerated anxiety.

Accordingly one of these handkerchiefs was seized and sent to M. Bayle. After three months of painstaking research this able chemist identified not only the active substance with which the handkerchief had been treated, though the bit of linen contained only a fraction of a milligram of the chemical, but what was far more important, he discovered the *specific developer* required to make it give up its secrets. In this case a catalytic operation is concerned which is so exquisitely sensitive as to furnish a reaction even in the case of solutions so tenuous as to contain only 1/100,000,000 of the active substance! The spy needed only to dip his handkerchief into a glass of water to obtain the invisible ink he needed.



Left: Before treatment the letter appears as an ordinary business document. *Right:* When given the correct treatment the real message appears, between the lines of the apparent one

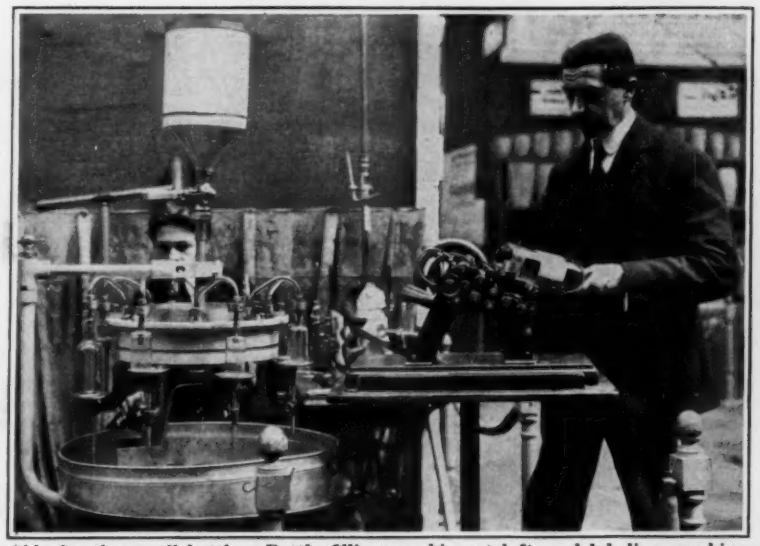
Letter of a spy, seized in course of transmission

Finally, for the safety of our own secret correspondence M. Bayle invented a special process communicated to the War Department May 6, 1918, for its sole use. In this method four different reagents must be employed *and in a given order.* Texts prepared by this method have been subjected to scrutiny by control committees, who have not succeeded in deciphering them.

Bottling and Labeling Machine for Small Scale Operations

QUITE distinct from the large and elaborate bottling equipment found in big bottling establishments is the small machine shown at the left of the accompanying illustration. This machine has been invented by a Frenchman who had in mind a small equipment especially intended for the small wine merchant. Obviously, the same machine can be used for bottling other liquids, such as oils, medicinal preparations, thin paints, and so on.

In brief, this filling machine depends on the fact that liquids always seek their own level, and on the use of the siphon. The wine or other liquid to be bottled is placed in the top container, from which it flows down by gravity into a large basin centrally located. Leading from this basin are a number of radially arranged siphons, the free end of each siphon being placed in the neck of a bottle, as shown. The various bottles, it will be noted, are placed on individual stands that can be adjusted to any height. In this manner the bottles can be so arranged that they will fill to any desired height automatically, since the siphon will stop delivering when the level of the central basin is attained. In this manner the operator can place the bottles one by one on the stands, and swing the machine around so as to remove the filled bottles and put empty ones in their place in a continuous operation.



Aids for the small bottler: Bottle filling machine at left, and labeling machine at right

The second machine shown in the illustration is a labeling machine. Labels are automatically picked up by an arrangement of rollers, given a layer of mucilage, and firmly and neatly applied on a bottle, can or other form of container. The machine is hand driven, and the arrangement of rollers is such that any size or shape of container can be taken care of by simple adjustments.

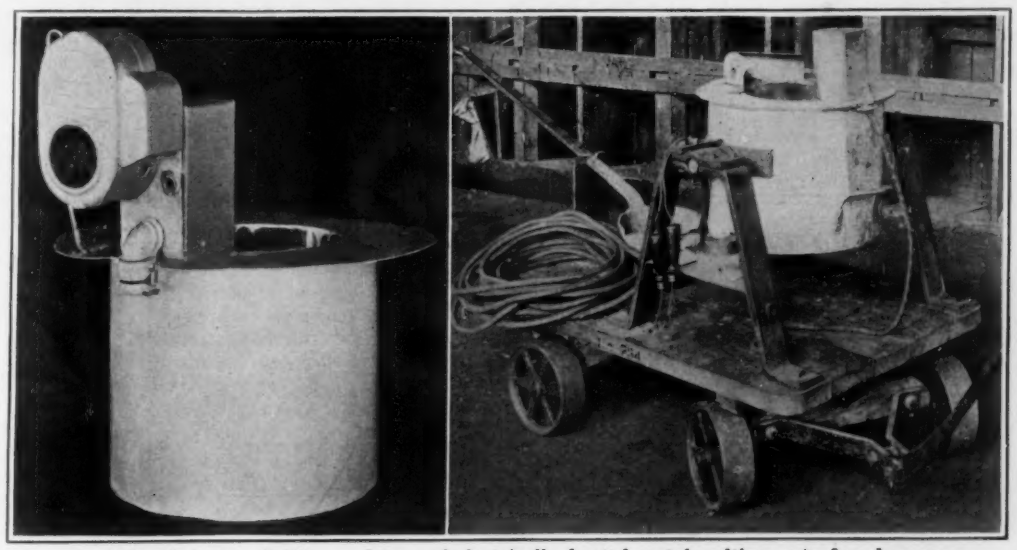
Applying Electricity to the Metal-Melting Pot

ELECTRICALLY-heated metal-melting pots are a decided improvement over gas and gasoline heated pots not only on account of their cleanliness, elimination of open flame and other obvious features, but also because they are more efficient and much more readily controlled. In the electrically-heated pot, the heat is generated and applied where needed. Workrooms are not overheated due to waste heat; the air is not vitiated. Electrically-heated pots, furthermore, effect a big saving in time and labor. The metal is kept at exactly the right temperature, and the pot does away with the dangerous and unsatisfactory practice of carrying small quantities of hot metal around in a ladle or bucket. The equipment can be installed wherever electric current is available.

Typical of the present electrical melting pots is the type shown in the accompanying illustration. This type is designed to melt down and maintain at the proper temperature all soft metals such as leads, tin, solder, babbitt, and so on. Pots of this type are limited to a maximum temperature of 550 degrees Fahrenheit.

The first pot shown is made in 10 and 25 pound sizes, with a maximum content temperature of 440 degrees. Having current requirements well within the rating of an ordinary lighting circuit, these two sizes can be used in any room where there is an electric light socket. The pot consists of two containers, made of strong sheet metal, placed one within the other. The ample space between the containers is provided with a packing of heat insulation which prevents loss of heat through radiation. The heat units are welded to the bottom of the inner container. Four feet of cord and a snap switch are provided for manual operation, or automatic control may be substituted.

The bench type of pot is practically the same as the smaller portable pots, except that the heater units are the flat, seamless steel type, and are immersed directly in the metal, with the lead arm coming out over the rim of the pot. With this construction all of the heat generated is transmitted directly to the metal, which is melted down with extreme expedition.



Small bench type and 100-pound type of electrically heated metal-melting pots for shop use

The automatic control equipment consists of a dynamic thermometer and a suitable control panel. The bulb of the thermometer is immersed in the metal and the operating coil, acting through the control panel, automatically opens or closes the heating circuit as the metal temperature rises or falls the very few degrees necessary to actuate the coil contact lever.

Standard Radio Wavemeter

THE Radio Section of the Bureau of Standards tests for government agencies, commercial and university laboratories, and others, a great variety of radio material, especially wavemeters. Not only in connection with radio communication, but also in a wide and growing field of electrical research, there is an insistent demand for accurate measurement of the wave length or frequency of rapidly alternating currents. In the standard wavemeter most recently designed by the Bureau, careful attention has been given to the electrical and mechanical considerations which make for accuracy, especially rigidity of construction, and precision of set and reading. This wavemeter, when calibrated, will be capable of measuring wave lengths from 65 to 85,000 meters, or in terms of frequency from 3500 to 4,600,000 cycles per second.

A typewritten description of this wavemeter has been prepared and is available for distribution to interested persons, who may apply to the Bureau.

Weights Constructed of Magnetic Material

A FEW months ago in investigating three imported sets of analytical weights, it was found that the weights from .5 to .05 of a gram were made of a decidedly magnetic material. During the past month a similar set, several years old, was likewise found to have magnetic weights which caused great irregularities when an attempt to calibrate them was made. Weights of this character can be readily detected by using a small magnet, and it is well for purchasers of analytical weights to be on their guard against them as under some circumstances serious errors may be introduced by using such weights.

Seeing Old Paintings as They Were Originally Painted

THERE has long existed the belief that the darkening of pigments which occurs in the course of hundreds of years enhances the beauty, and therefore the value, of old and rare oil paintings. However, it has remained for a French scientist, M. Pierre Lambert, to reveal any old oil painting in its original colors so that a comparison of the original color values and these bestowed upon the canvas by the lapse of years may be made.

First of all, M. Lambert illuminates the old oil painting by means of a powerful arc or gas-filled incandescent lamp and a novel optical system. The rays from the illuminant are passed through a condenser, followed by a lens and a polarizing device known as the Nicol prism, and again a lens which spreads or diverges the rays, so as to illuminate the entire area of the painting. The observer, looking through the Nicol prism, manipulates the prism until he finds a position in which superficial reflections are entirely suppressed. It is said that old dull pictures then become quite distinct, the colors are intensified, and details that have long been lost to the naked eye are revealed in their original form. Aside from its pure art value, the instrument should be of great use in detecting forgeries on which the marks of age have been artificially laid.

Apparatus devised by a French scientist for the purpose of examining old paintings under polarized light and with the aid of the Nicol prism, in order to suppress superficial reflections

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Design Patents

What They Are, and the Rules Governing Recovery for Infringement of Them

By T. Hart Anderson of the New York Bar

PATENTS for designs secure to the owners thereof the right to exclude all others from manufacturing, using, and selling articles of manufacture embodying an infringing design. Thus the owner of a design patent is entitled to an injunction to restrain not only the unauthorized manufacture of articles embodying an infringing design, but also the unauthorized use and the unauthorized sale of such articles of manufacture. In addition to this injunctive relief the owner of a design patent which has been infringed is entitled to recover from one who has manufactured and sold articles of manufacture embodying an infringing design, all the profits which have accrued from such manufacture and sale, and if there be no such profits, or the amount thereof is less than would have been made by the owner of the patent had he sold the same number of articles, then he may recover a sum equaling what he would have made, under the assumption that he would have manufactured and sold such articles if the infringer had not done so. Of course, the right to recover presupposes the validity of the design patent, and that the owner thereof has given notice of his patent by affixing to the articles of manufacture embodying the design, the word "Patented," together with the date of the patent, or has given actual notice to the infringer, in which latter case at the trial he must not only prove such notice but must further prove that *after the receipt of such notice the infringer continued his infringing acts.* Damages can only be recovered when the statutory notice has been given. (R. S. Sec. 4900.)

The law relating to design patents contains a provision specifying a minimum sum which may be recovered for the infringement thereof. This is contained in the Act of February 4, 1887, which reads as follows:

"Act of February 4, 1887:

"Be it enacted, etc., That hereafter, during the term of letters patents for a design, it shall be unlawful for any person other than the owner of said letters patent, without the license of such owner, to apply the design secured by such letters patent, or any colorable imitation thereof, to any article of manufacture for the purpose of sale, or to sell or expose for sale any article of manufacture to which such design or colorable imitation shall, without the license of the owner, have been applied, knowing that the same has been so applied. Any person violating the provisions, or either of them, of this section shall be liable in the amount of two hundred and fifty dollars; and in case the total profit made by him from the manufacture or sale, as aforesaid, of the article or articles to which the design, or colorable imitation thereof, has been applied, exceeds the sum of two hundred and fifty dollars, he shall be further liable for the excess of such profit over and above the sum of two hundred and fifty dollars; and the full amount of such liability may be recovered by the owner of the letters patent, to his own use, in any circuit court of the United States having jurisdiction of the parties, either by action at law or upon a bill in equity for an injunction to restrain such infringement."

It will be noted that it is unlawful for anyone, other than the owner, without the license of the owner, to apply the design to an article of manufacture for the purpose of sale, or to sell or expose for sale such an article knowing that the design has been so applied. It is further provided in this section that anyone violating these provisions shall be liable in the sum of $250, or if the total profit arising from such infringing acts exceeds the sum of $250, he shall be liable for the excess over and above that sum.

How shall a dealer know that a patented design has been applied to an article of manufacture *"without the license of such owner"?* Obviously, in the case of an infringing manufacturer mere knowledge of the existence of the patent of another is sufficient, for if he knows of the existence of the patent and he does not have the license of the owner of that patent, he knows that he is manufacturing for the purpose of sale an infringing article, to which the design has been applied without the consent of the owner of the patent, so that so far as the manufacturer is concerned it is only necessary to prove that the owner of the patent has given to the infringing manufacturer statutory notice as hereinbefore set forth. It is not necessary to prove that he has no license; if he has a license it is for him to prove the fact.

But how about a retailer? He may know of the existence of the patent from the statutory notice applied by the owner to the articles which the owner makes and sells; but how can a dealer possibly know unless specifically advised that articles of manufacture offered to him by other manufacturers embodying the same design have had the patented design applied thereto without the license of the owner of the patent? Retailers are offered the same article by different manufacturers. They are not supposed to inquire when they are solicited to purchase articles for resale whether such articles are patented or not, or whether any particular design has been applied thereto with the license of the owner of a design patent. A retailer, therefore, who sells or offers for sale articles of manufacture to which has been applied an infringing design is not liable for the penalty of $250 unless it is proved that he knew of the patent, and also that before he offered the same for sale or sold the same he knew that the design had been applied to such articles without the license of the owner of the patent. This does not mean, however, that he is not liable at all, for if he has sold an infringing article he may be sued under proper conditions precedent, such as notice of the patent for the purpose of recovering the profit which he has made by the sale of the infringing articles, which may or may not exceed the sum of $250; but the owner of the patent has no right to demand the penalty in the absence of proof of knowledge on the part of the retailer before he sold the article, not only that the design is patented, but that it has been applied to such article *without the license of the owner of the patent.* Should a retailer get notice that an article offered for sale and sold by him constitutes an infringement of a design patent it will be sufficient for him in order to avoid the payment of the penalty of $250 to at once take the infringing article off sale and to notify the owner of the patent of that fact. If after the receipt of such notice he makes a sale of an infringing article, even of a single specimen, or offers the same for sale, he will be liable for the penalty.

This question came up and was decided by the Circuit Court of Appeals for the Third Circuit, in a very able opinion written by Judge Acheson in the case of Gimbel vs. Hogg, 97 Fed. Rep., page 791, wherein the court states:

"By the plain terms of the statute, the penalty is incurred by the seller of an article to which a patented design has been applied without license, only where he sells 'knowing that the same has been so applied.' The statutory punishment is for infringing knowingly. Clearly it was not intended to subject to a penalty a vendor acting in good faith and selling in entire ignorance of any infringement perpetrated by the manufacturer. For the infliction of the penalty the statute contemplates and requires knowledge by the seller of the unauthorized use of the design by the manufacturer. Such knowledge is not to be imputed to the seller from the 'notice to the public' by the marking required of the patentee by Section 4900 of the Revised Statutes."

In the same decision it was held that such notice was sufficient against the manufacturer who applied the design because he must know, if he knew of the patent, that he did not have a license thereunder. The court further stated in that decision:

"But the public notice by marking, under Section 4900, gives no information whatever to a seller of an infringement committed by the manufacturer, and that section has no such purpose."

There has been a campaign in recent years, particularly in the lighting fixture trade, whereby certain owners of design patents have proceeded against manufacturers of infringing articles, and when they have been so fortunate as to have had their patents sustained against the manufacturers they thereafter proceed against retailers who have sold articles purchased from such manufacturers, and such retailers have been led to believe that the owner of the patent is also entitled to collect the penalty of $250 from the retailer who offers for sale and sells such infringing articles, and in many instances—sometimes where the retailers have sold only two or three specimens of the infringing articles—they have been induced to pay this $250 rather than stand the expense of a suit. In all such cases the owner of the patent was not entitled to recover the penalty unless he could show that the retailer not only knew of the patent, but also knew when he offered the infringing articles for sale and sold the same that the design had been applied thereto without the license of the owner of the patent. It is believed that in many of these cases the retailers have been absolutely without this knowledge. They may have known of the patent, but it is doubtful whether they knew or took the trouble to find out—and they are not obliged to take the trouble to find out—that the design had been applied to such articles without the license of the owner of the patent.

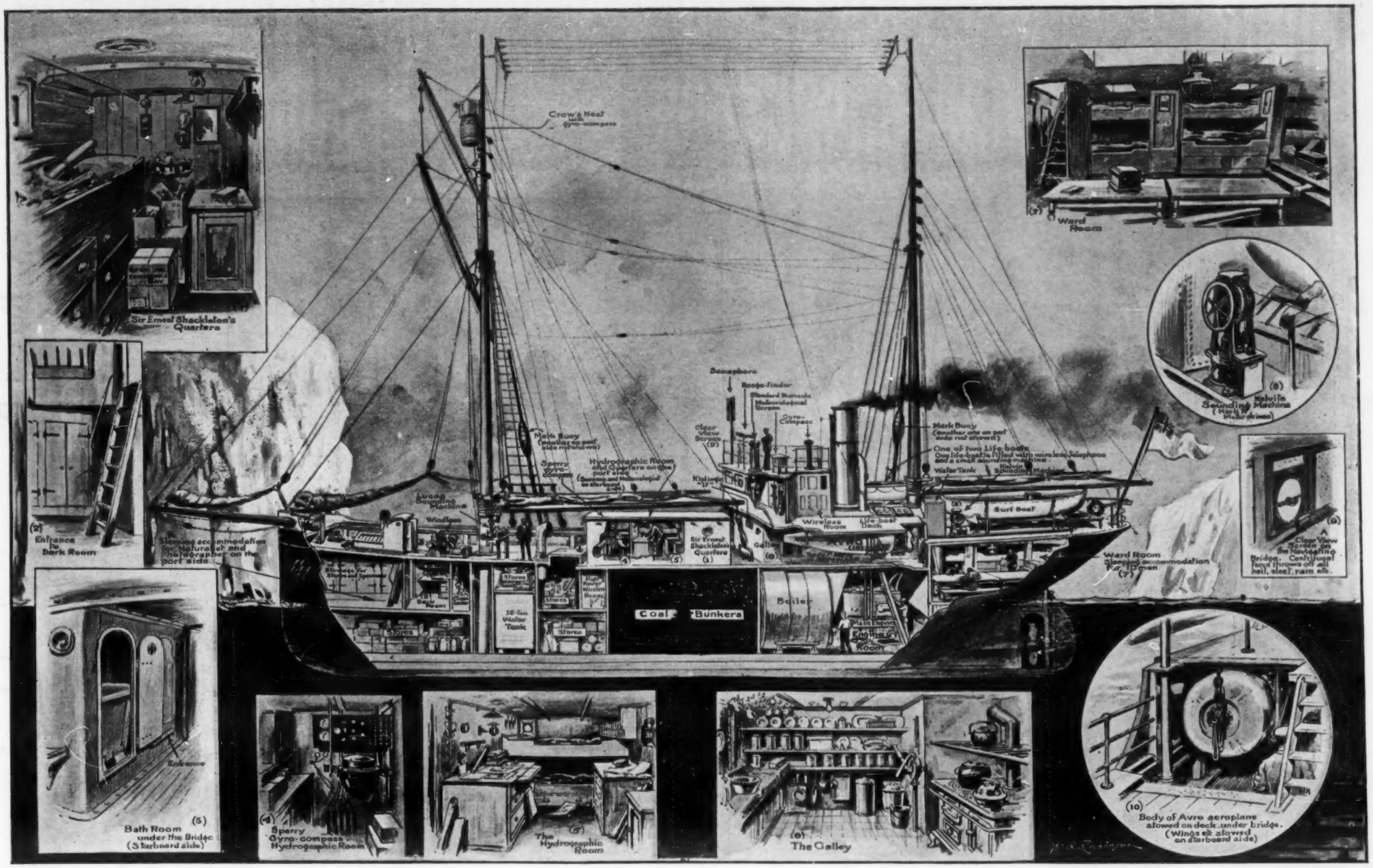
In no event can the owner of a design patent recover the penalty of $250 from a dealer unless in addition to the notice of the patent the dealer is notified that the design has been applied thereto without the license of the owner of the patent, and after the receipt of such a notice offers for sale or sells such infringing articles. In order to render a dealer liable for the penalty the notice must be specific—not only that the design is patented, but that those articles offered for sale by him have had the design applied thereto without the license of the owner of the patent. If after the receipt of such a notice the dealer at once ceases the sale of such infringing articles he can not be held liable for the penalty. Design patents should be respected quite as much as structural patents, and when one has knowingly infringed he should be made to answer to the owner; but the penalty is only incurred under the circumstances here noted.

THERE appears to be a good deal of doubt and misunderstanding in the mind of inventors as to just what ground is covered by a design patent. At the same time it is not altogether clear to the retail merchant just what protection he has against penalties for unintentional and unknowing infringement of a design patent. It is to clarify this matter that we have asked Mr. Anderson to prepare the article that appears on this page. We believe he makes it entirely clear that a design patent is on substantially the same footing as a patent of the more usual variety, while at the same time the innocent third party to an infringement is amply protected.—THE EDITOR.

Facts of Importance in Regard to Relief of Eye Fatigue in Industry

INSUFFICIENT illumination represents an abuse of the eyes, and a careful regulation of the illumination in our factories, offices, homes, etc., should be observed in order to support our eyes in their functioning, says *Electrical Review.* How can this best be accomplished? The answer must be: "Study Daylight Effect."

The following specific points are cited: (1) Dark corners should be illuminated with diffused indirect light of sufficient intensity to prevent excess of contrast of all illuminated objects in areas surrounding them. (2) The eyes should not be exposed to direct light sources of any kind. (3) The excess of the yellow light from most of our artificial light sources should be neutralized by blue filters of suitable tint in order to approach daylight color. It is not necessary to obtain absolute standard daylight quality as determined spectroscopically, since our light sense overcomes a considerable variation of color combinations in the light source without experiencing fatigue. (4) When work is to be done on bright light-reflecting surfaces the illumination should be as much as possible of a grazing incident so that the light rays may not reflect direct into the eyes of the worker. (5) Cheerful surroundings, well illuminated, add a great deal to the comfort of the individual—remember that seeing is a nerve action. (6) Attractive soft color schemes of variety in workrooms will prove to be refreshing to the eye; monotony in color should be avoided. (7) Neither red walls nor pure white walls are inviting; the former tend to fatigue, the latter glare and tire the eye. Neutral gray as a base color is restful to our eyes, while bright multiple color effects are exciting. (8) Fine detail work does not demand brilliant illumination; a soft velvety light of moderate intensity will prove far more satisfactory in order to prevent eye fatigue. For extremely fine detail work optical appliances should be made use of in order to magnify the images of such objects on the retina; illumination alone will not suffice.



THE little "Quest" is the ship of the Shackleton-Rowett Oceanographical and Antarctic Expedition, led by Sir Ernest Shackleton, and financed by Mr. John Quiller Rowett. She recently sailed from London Bridge on a voyage of 30,000 miles, expected to occupy two or three years. One of the objects is to find various doubtful or unidentified islands which might be useful as whaling, coaling, or wireless stations. Others are to make a hydrographical survey, to obtain ocean soundings and meteorological information for the Air Ministry, which provided instruments, balloons, and kites. The equipment of this little ship is unusually complete and should afford the maximum comfort to the men engaged in a most interesting work. A Baby Avro seaplane is carried, as shown in the drawing for which we are indebted to the *Illustrated London News*. The "Quest" was built in Norway in 1917 for sealing in the White Sea. Her hull is of stout oak and pine specially designed for withstanding ice pressure, and the bows are strengthened with steel. She is only 111 feet long, and of about 200 tons. She carries 120 tons of coal, and has a steaming radius of 9000 miles. The central drawing shows the details of the ship, and the numbered portions (1 to 10) are illustrated on a larger scale in the margin with numbers corresponding. No. 3 (the bathroom) does not appear on the central drawing, as it is on the starboard side. In Sir Ernest Shackleton's quarters may be noted a box marked "Open on Christmas Day." In front of the bridge is a brass plate inscribed with three verses of Kipling's poem, "If." The Sperry gyro-compass (No. 4) depends for its action on the earth's rotation and the force of gravity. It is non-magnetic, and always shows the true geographical north and south. Of the two sounding machines, the Lucas (near the fore mast) is for stationary deep-sea and hydrographic work, and the Kelvite for "flying" or navigational soundings with the ship in motion. The radio equipment has a range of 1500 miles by day and 3000 miles at night. The wings of the airplane are stowed on the starboard side of the same deck as the body.

THE "QUEST," A NORWEGIAN SEALING SHIP WHICH HAS BEEN REFITTED FOR SIR ERNEST SHACKLETON'S NEW ANTARCTIC EXPEDITION

Recent Discovery in Greek Lands

A Sketch of the Principal Excavations and Discoveries of the Last Fifty Years

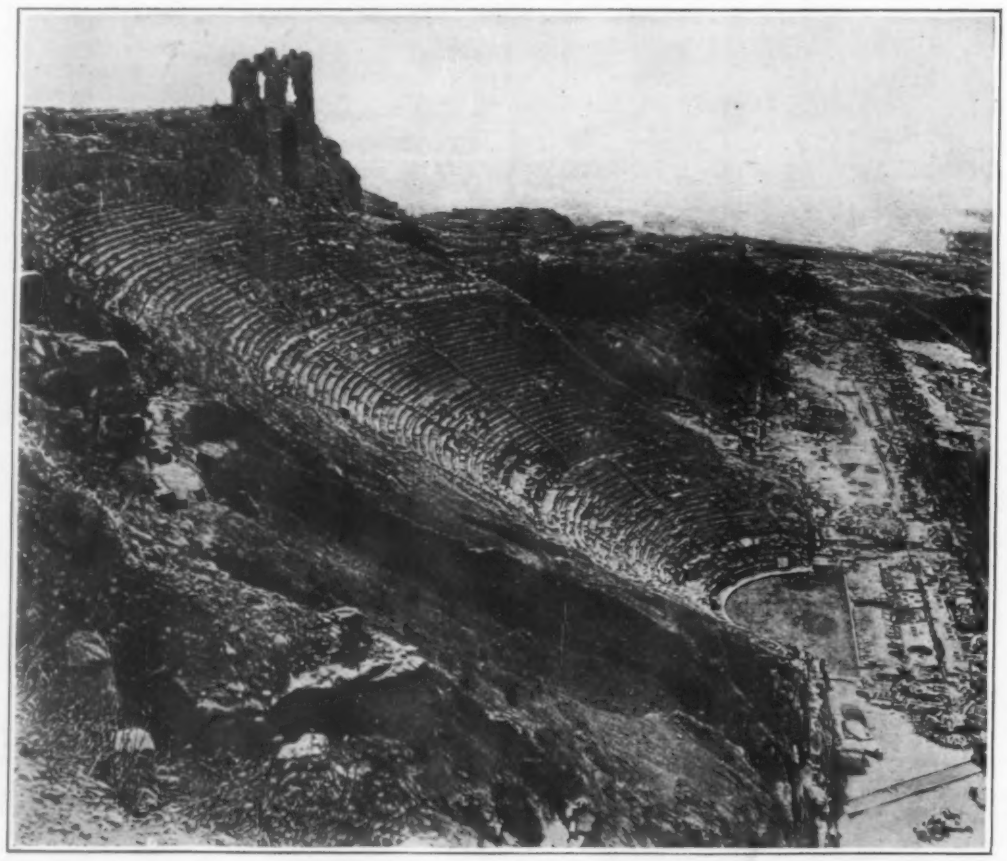
PROFESSOR F. H. MARSHALL, of Birkbeck College, London, has recently given us a work of little more than one hundred pages, which will undoubtedly appeal to the general reader. Nearly everyone wants to know something of the progress of discovery in Greece and Greek lands, and through the courtesy of the Cambridge University Press we have been enabled to use some of the pictures from Professor Marshall's book.

The explorations since 1870, in chronological order, naturally fall into well-defined geographical groups. The first group, Northern Greece, begins in 1871 and includes the quarter of Athens near the Diplon gate. These excavations were carried on for twenty years. The remains belong to the later prehistoric period, or about 1000-700 B. C. In 1873-4 the world was startled because of the striking beauty of the finds at Tanagra, where an unrivalled series of terra-cotta statuettes was found, for the most part women in their picturesque costumes. Systematic excavations of the tombs showed that the graves were of several forms. Sometimes rock-hewn, sometimes built up of stone slabs; the dead were frequently buried in sarcophagi, in which the figurines were found with other objects. Some of the statuettes were archaic, but the bulk are of the fourth century B. C. In 1875 we have excavations at Dodona, and in 1892 the Delphi sanctuary in the northern part of Greece both devoted to oracles. From 1880 to 1886, Dr. Henry Schliemann carried on excavations at Orchomenos, and discovered in the latter year a remarkable beehive tomb. Between 1882 and 1887 the Greek Archæological Society completely cleared the temple site at Eleusis, the great center of the mysteries of Demeter and Persephone. These excavations have given us some extremely valuable remains. A sanctuary oracle of minor importance was that of Amphiaraos which lies among hills near Oropos; it was excavated between 1884 and 1887. Part of the temple plan, a long colonnade in which patients probably slept when awaiting the dream-revelations, and a small theater were uncovered.

Some of the most important excavations ever made on the mainland of Greece were those of 1884 upon the Acropolis of Athens. The excavations were begun at the Propylaea and continued round the Acropolis, resulting in the discovery of a very early "Pelasgic" wall. To the south of the Erechtheum the remains of an early sixth-century temple, the "Hekatompedon," or temple one hundred feet in length, came to light. Very important sculptures in soft stone belonging to this early temple were found; these were originally colored, a device which would go far to conceal defects in the stone. Another sanctuary site was excavated on a three-peaked mountain of Bœotia at Ptoïos in 1885-6. Inscriptions throw light on the worship of Apollo Ptoïos. The temple had the right of asylum, and there was also an oracle attached to it.

In Bœotia, four miles to the west of Thebes, the temple of the Kabeiri was excavated by the Germans in 1887-8. The temple, though several times reconstructed, was in existence from early Greek to Roman times. It is of peculiar structure, having four internal divisions instead of the normal three. The Kabeiri seem to have been deities of a subterranean character, half goblins, whose worship flourished in the island of Samothrace as well as in Bœotia. At Thebes they are found in the relationship of father and son, as may be judged from the objects excavated from the temple. The potsherds frequently show grotesque scenes and parodies, while several votive objects, such as bells, wheels, figures of bulls, and terra-cotta models of tops, are inscribed with dedications to the two deities.

Map showing the principal sites of discoveries in Greek lands, after Marshall



Theater at Pergamon, seen from the north

The most famous oracle of Greece was at Delphi, situated amid rugged mountain scenery in Phokis. Various preliminary excavations were carried out in 1840, 1860-1, 1880-7, but the main excavations were conducted by the French School under M. Homolle from 1892 to 1903. We first enter the sacred precinct at the southeastern corner of the sacred way. Here on either side were the various offerings made by the different states, such as the bronze bull dedicated by the Corcyræans, and the 38 bronze statues erected by the Spartans in commemoration of their victory at Ægospotami. Next came the various "treasuries," small shrines dedicated by the various cities of the Greek world. Most of these treasuries are situated near the bend of the sacred way toward the north.

Strabo attributes the greatness of Delphi to these treasuries "which peoples and kings founded, and into which they placed their dedicated wealth, and the works of the greatest artists." True to this description, the treasure houses have furnished some interesting sculptures. That of the Sikyonians, built about 580 B. C., has a score of metopes, the subjects of which are identified by inscriptions—Europa carried off by the bull, Helle on the ram, the hunt of the Kalydonian boar, etc. The most striking series is, however, that furnished by the treasury of the Knidians, built about 510 B. C., the façade of which, as restored in the Museum of Delphi, is shown on p. 37. The frieze represents on the left an assembly of the gods, on the right a combat between the Homeric heroes and Æneas on the Trojan side and Menelaos and Meryon on the Greek side. They are fighting over the body of Euphorbos. In the pediment or triangular gable is a group representing the legendary struggle of Apollo and Herakles for the Delphian tripod. The foreground in the illustration is occupied by the colossal figure of a seated sphinx, probably an offering of the Naxians made in the first half of the sixth century, B. C. It originally stood on a column south of

the retaining wall of the temple of Apollo. The remains of this famous temple of Apollo, in which the Pythia gave the inspired oracles of the god, are scanty, for it was much rifled for building material in the Middle Ages.

Excavations were made in 1897-1905 at Thermos, in 1899 at Megara, in 1901 at Ægina and 1907-8 at Rhitsona.

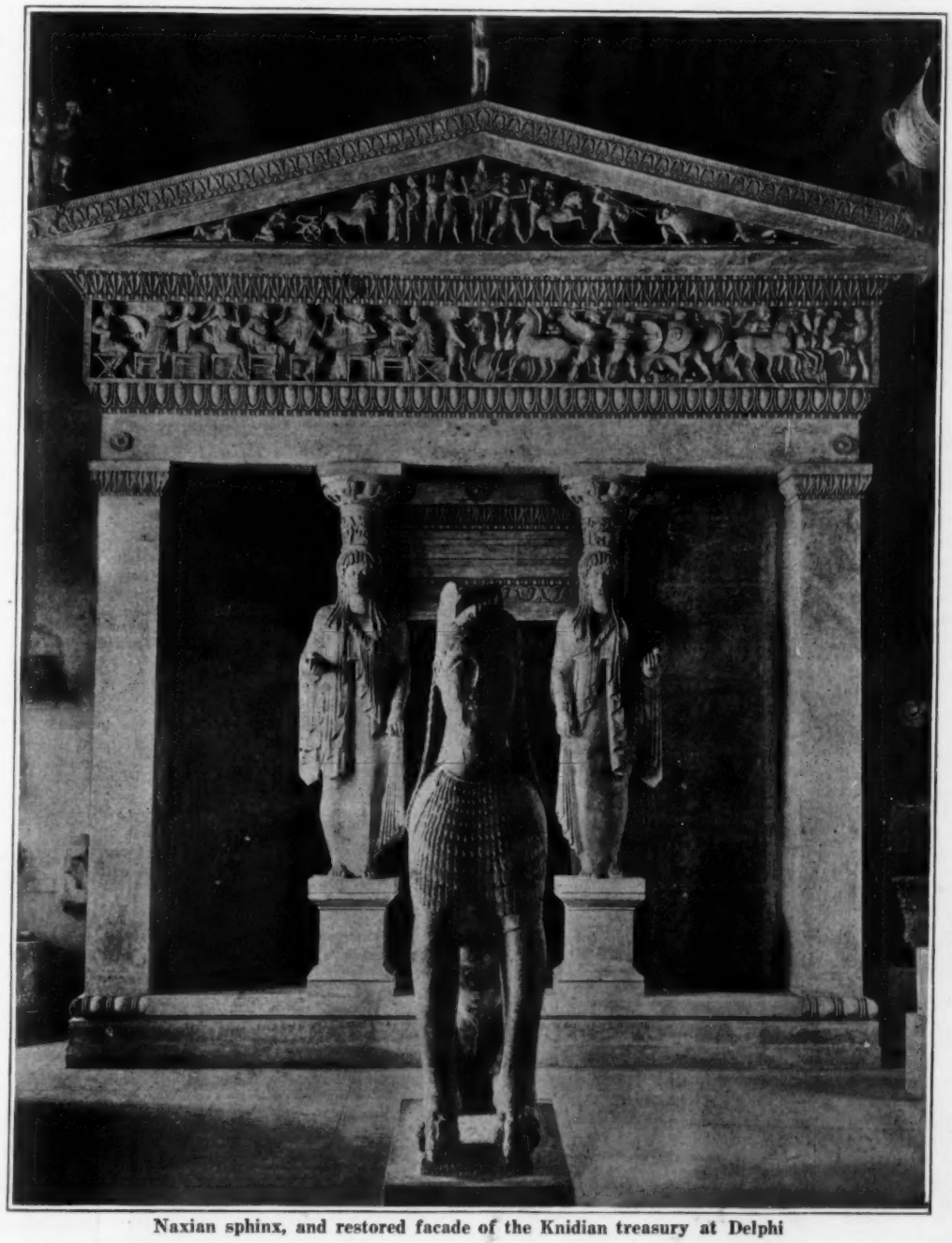
Having now finished with Northern Greece, we come to the long list of explorations in the Peloponnesos. The work of the greatest interest is undoubtedly that at Mycenæ (1874-6) and Olympia (1875-8). The center of Mycenæan civilization seems clearly to have been Mycenæ, famed in the Homeric poems as the home of Agamemnon, who led the great expedition against Troy, and famed, too, for its wealth in gold. Mycenæ is situated on hills which rise from the Argive Plain, some nine miles from the sea. It consists of two distinct parts —a high town, or acropolis, and a lower town. The acropolis, which is the older part of the city, was first excavated by Dr. Schliemann in 1876. Beneath the acropolis to the west and southwest lies the lower city of Mycenæ. Here an area of some 1000 by 275 yards was enclosed within walls. The most important remains of this city are the "beehive" tombs, two of which have been found within the walls of the lower town, five outside.

Olympia was the great center of Greek athletic life in Elis in the Peloponnese, a site famous for many reasons, but perhaps not least as supplying the theme of many of Pindar's most majestic odes. The sacred precinct, or Altis, which lies in a broad plain between the rivers Cladeus and Alpheus, was excavated by the German Government between 1875 and 1881, although the Temple of Zeus had previously been explored by a French expedition in 1829.

Other excavations were carried on from 1880 to 1909 in chronological order, as follows: Tegea, Epidauros, Tiryns, Mantinea, Lykosura, Vaphio, Megalopolis, Argos, Corinth and Sparta. The author describes each site and what was found there in detail. The most interesting discoveries, perhaps, in this list were those at Argos, 1892, carried out by the American School and the older excavations of Tiryns, so famous in Homeric poems.

We find that very important light has been thrown on ancient Corinth by the American excavations begun in 1896 by their school at Athens, and continued in succeeding years. Perhaps the most interesting discovery is that of the famous fountain of Peirene, which an ancient traveler, Pausanias, in the second century, after Christ, described. In 1898 the façade of this Shing was discovered, and the different stages of its building can be traced from the first simple grottoes, with cross walls to support the roof, to the elaborately veneered façade of Roman times, which has in front of the grottoes arches decorated with Doric and Ionic half-columns.

Leaving the mainland our author deals with the discoveries of extraordinary interest made in the islands, particularly Delos, Melos, Crete, and Cyprus. He deals also with the discoveries in Asia Minor at Ephesus, Troy, Pergamon, Priene, Miletus and Sardes, as well as places in Syria and Egypt, such as Sidon, Naukratis and Daphnæ. The excavations of Troy by Drs. Schliemann and Dörpfeld are too well known to do more than refer to. The excavations at Pergamon are less well known. This city has been compared in its general situation with Edinburgh. The acropolis, which rises nearly a thousand feet, corresponds to Edinburgh Castle; the Hellenistic town at its foot to the Mediaeval part of the Scottish capital, and the Roman city on the outskirts to Edinburgh New Town. The excavation of the acropolis was begun by the Germans in 1878, and the first and most striking discovery was that of the sculptured slabs of the Great Altar of Zeus. Another structure belonging to this city, the theater, presents a remarkable appearance when viewed from above, and is a good instance of the way in which the Greeks took advantage of a natural slope for theater construction.



Naxian sphinx, and restored facade of the Knidian treasury at Delphi

The location of the various sites will be readily found from the excellent map which accompanies Prof. Marshall's book. He arranges his facts as to discoveries in chapters dealing with the great periods—the earlier prehistoric, the later prehistoric, the earlier historic and the later historic period. There are also chapters on temple sites, and some isolated discoveries. There is also a select bibliography which covers the ground admirably and a chronological list of excavations which we have used as a guide for our all too brief notice, using it to hark back to Prof. Marshall's text. The book gives in condensed form what the average reader wants to know with all the unnecessary details eliminated. Other books on archæology so admirably abridged in the treatment of interminable non-essentials would be very welcome.

The Strength of Papers

IN a new publication of the Bureau of Standards, Technological Paper No. 194, entitled, "A Preliminary Study of Tearing Instruments—Tearing Test Methods for Paper Testing," a study is made of the relative effect of different sizes of test samples on the tearing strength of paper. Data are presented to show that the larger the test samples, the greater are the values of tearing strength. There is also taken up a study of two types of tearing instruments on the market. The degree of accuracy of each instrument is determined, and the errors are plotted in the form of curves. In the conclusions, the good and bad qualities of these instruments are discussed at length.

This publication is now ready for distribution and anyone interested may obtain a copy by addressing a request to the Bureau of Standards until the free stock is exhausted.

The Mount Everest Reconnaissance

OFFICIAL accounts have come through of the July-August activities of the scientists investing Nature's mightiest fortress in the hope of taking it by escalade. A month was spent in trying the northern and western approaches, only to end in the conviction that both faces present insuperable difficulties to any material advance. The south side also presented only unclimbable precipices, and the remaining hopes centered on the east and northeast faces. Breaking camp at Tingri, the adventurers had, in crossing a spur from Chhoebuk to Rebu, a magnificent view of the northern face of Everest almost encircled by great bands of perpendicular black rock that seem absolutely unscalable. Pressing forward, some fine scenery was opened up with a background of glaciated peaks 23,000 to 24,000 feet high. Two miles down the Arun valley, one of Everest's big glacier streams was encountered. Here, on an old river terrace, the new base camp was pitched at more than 12,000 feet. Col. Howard-Bury gives piquant thumb-nail sketches of a neighboring high-level valley with 14 lakes varying from black-green to turquoise blue; the ground was carpeted with many varieties of gentians, with embossed designs in rhododendrons and deep-claret meconopses.

On August 2nd Messrs. Bullock and Mallory started to explore the eastern approaches; up to this time photographic surveys and maps had been made covering more than 9000 square miles of new country. The explorers were striking for a valley that apparently led direct to Everest; they passed prosperous villages and monasteries that scanned a majestic panorama from Langmala (18,000 feet). Four thousand feet below them lay three giant glaciers, one of which came from Everest. Descending, they pushed forward in the face of great difficulties; ascending again, they found themselves on a spur immediately opposite Mt. Everest, the air filled with the thunder of falling ice as huge masses broke away from the suspended glaciers and plunged into the Kangshung glacier below. The climbers were attempting to discover into which of two valleys the glaciers came down. As to the main issue, the disappointing conclusion was reached that the eastern face of Everest afforded no possible means of reaching the summit. The return journey, by another route, led across the Field of Marigolds, opposite Makalu peaks.

A Garbage Crisis

Must We Solve Anew the Problem of the Disposition of Domestic Wastes?

By Harry A. Mount

OH, for a Moses of the Garbage Can! For forty years engineers in this country have been leading certain industries and our municipalities toward a Promised Land, where garbage and similar materials would cease to be merely wastes that must be disposed of at large expense, but would be made to yield valuable products which would pay for their disposal, or might even show a balance on the profit side of the ledger.

Now it appears that what we thought was the Promised Land just ahead was perhaps only a mirage, for an economic condition has arisen which apparently makes the plan impossible of success and all of the progress of nearly a half a century along this line may be wiped out. Where is the man, or where is the idea, that can save the $7,500,000 invested in garbage reduction plants still operating, which embody the best thought American engineers could offer to those confronted with a problem of garbage disposal?

In brief, the present-day system of garbage reduction (the only system which seeks to turn to economical use the constituents of garbage) is founded on the thought that some of the contents of garbage are valuable. Destroy this value and the whole system falls. That is what has happened.

Garbage ought to be regarded as a liability and not an asset. The problem primarily is to be rid of the garbage as cheaply as possible in an inoffensive manner. Normally the reduction process meets these requirements perfectly, and, as well, salvages the useful material present.

The principal material salvageable from garbage is grease. For the ten years prior to the war this grease found a ready market among soap and candle makers. The value of garbage grease reached a peak during the War and it seemed as if the success of the scheme was certain. But since the signing of the armistice this country has been flooded with millions of pounds of oils from the Orient, and tallow from South America, produced in these countries so cheaply that competition with them is impossible. These products have the additional advantage that they are cleaner than garbage grease and therefore do not have to be so thoroughly processed by the soap or candle maker. The South American tallow supplies candle makers with a first-rate product at a minimum of cost and the soap maker has his choice of such Oriental products as soy bean oil, non-edible fish oils, and wool grease. These come chiefly from China, Japan, Korea, Manchuria, and India.

In the ten years from 1905 to 1914, inclusive, garbage reduction plants had no difficulty in disposing of their garbage grease at an average price of 4¼c a pound. During the war, two or three times that much could be had and the demand greatly exceeded the supply. Now the best price obtainable is from 1¼c to 2c a pound (dependent on quality and distance it must be hauled), and there is little or no market at any price. This fact, coupled with other unfavorable circumstances, has made it impossible to operate a garbage reduction plant except at a large loss. This means that all of the privately owned plants which have not already shut down will soon have to do so, and sooner or later the municipal plants must follow their example.

The tragedy is not so much in the money loss involved as in the fact that the state of the art will be set back a good forty years. There is no other method of garbage disposal which has been widely accepted as satisfactory.

It is true that there are methods of garbage disposal now in use which are much more widely used than reduction, but these are admittedly makeshift methods or of doubtful economic value.

It is true, also, that there is a great diversity of opinion as to whether reduction is the best method of garbage disposal. But the idea has been steadily gaining ground in the past few years and with improvement in machinery and methods it has shown steadily better results. The system as it is usually carried out consists in "digesting" the garbage by steam cooking under pressure in large tanks. This breaks down the materials so that the grease can be extracted. The solids which remain are partially dehydrated and sold as "tankage" for use as fertilizer.

Top view of garbage digesters

The optimism with which the process was generally regarded may be surmised from the following paragraph from a bulletin issued in 1919 by the Department of Agriculture:

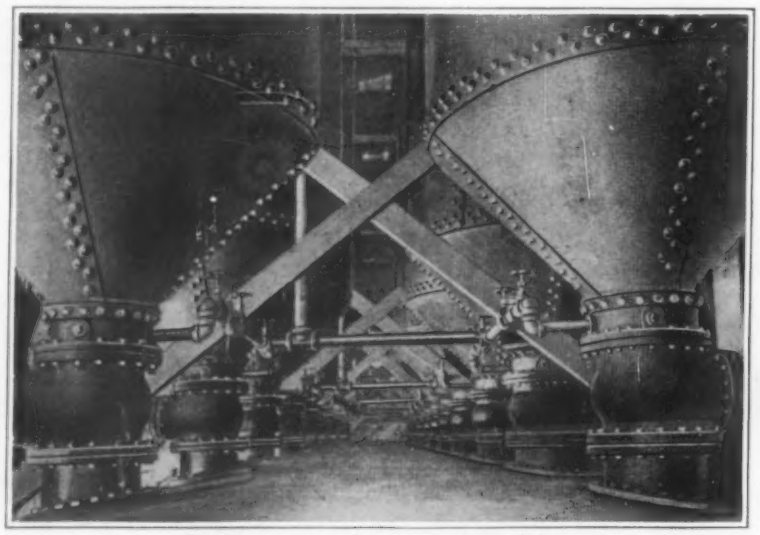
"Several important sources of recoverable fats and oils are still overlooked in this country. One of the promising of these is city garbage. Some idea of the total amount of grease that might be recovered from our domestic wastes may be gained from the actual yield of 4,000,000 pounds from the reduction plant operated by the city of Chicago. Armour & Company contracted to buy this quantity of grease from the city at a price of 11.57 cents a pound in 1918 and the Emery Candle Co. pays 13.5 cents a pound for a similar grease obtained from Washington garbage. It has been stated by an authority on the subject of garbage disposal that 30,000,000 pounds, over $3,000,000 worth of grease, which could be converted into 4,400,000 pounds of nitroglycerine and almost 40,000 twelve-ounce cakes of soap, goes to waste in 24 hours in our large cities alone. If this garbage from a combined population of 5,000,000 were properly utilized, we would get, in addition to the grease, 60,000 tons of fertilizer, sufficient to grow a 3,000,000 bushel wheat crop."

W. J. Springborn, a noted authority on garbage disposal, estimates that under normally favorable conditions, the reduction system might be expanded to economically care for the garbage from all American cities of more than 100,000 population. From these there could be recovered yearly about 135,000,000 pounds of grease and 265,300 tons of fertilizer, the combined value of which would be nearly $11,000,000. The railroads would receive nearly $2,000,000 for hauling the grease and fertilizer and another $725,000 for freight on coal and other supplies needed by the plants.

As a matter of fact, during the war even better results than these were obtained from our army cantonments. The situation was most favorable, here, however, because the separation, collection, etc., of the garbage could be most closely controlled. In spite of the fact that wherever a good dumping place could be found (as a large body of water) no attempt was made at reduction, the sale of the camp wastes developed a revenue of more than $1,000,000 a year.

At this writing twenty-four large garbage reduction plants are still in operation in this country, many others having shut down. Of these plants, fourteen are owned by municipalities, as follows: Chicago, Philadelphia, Cleveland, Indianapolis, Washington, Rochester, Columbus, Syracuse, Dayton, Bridgeport, New Bedford, Wilmington, Del., Reading, and Schenectady. The remaining ten are operated as private enterprises and dispose of the garbage of one or more cities each on a contract basis.

In addition to these, numerous plants have closed down all over the country. A great plant on Staten Island, constructed by private enterprise at a cost of more than $3,000,000, to dispose of the garbage from New York City, has recently been sold as junk for $225,000. The immediate prospect is most uninviting. What is to be done? Cities must continue to dispose of their garbage in as nearly as possible an inoffensive manner regardless of the merits of the several systems of disposal or the economic situation.



The digesters as they appear from below

It would seem at first thought that great hog farms might solve the garbage problem for large cities. It is pretty generally a practise among smaller American cities to feed the garbage to hogs. Rudolph Hering, a New York engineer, who has been the most prolific writer on the subject of garbage disposal, has this to say of hog feeding in a book just off the press:

"The method of disposal by feeding to hogs has spread to many cities. With pork at present prices, garbage will produce from $7 to $8 in value per ton. Thus for communities where the garbage can be properly collected and controlled, no other method shows equally high returns."

It ought to be noted that the last qualifying sentence almost always limits the usefulness of hog feeding to small cities because it is impossible to control and collect properly the garbage in large cities, or at least because only part of such garbage is useful for hog feeding. Furthermore, it has been pretty definitely proven that garbage is not the best food for hogs under any circumstances and that garbage-fed hogs are particularly susceptible, because of lowered vitality, to cholera and other diseases. This introduces into the business of hog feeding a gambling element that increases as the size of the herd and the size of the city furnishing the garbage increases. In spite of these facts several large cities now feed their garbage to hogs, notably Albany, Denver, New Haven, Providence, Springfield, Mass., and Worcester. Many other cities feed to hogs only the choice parts of the garbage, such as is secured from hotels and restaurants, and dispose of the remainder in some other way.

About the only other methods of garbage disposal are

to dump the waste into some large body of water, throw it on a dump, bury it, and burn it. New York City now utilizes the first of these methods and hauls its garbage to sea and dumps it. But inland cities usually have to choose some other method; and even New York finds the method of dumping at sea not entirely satisfactory, since the barges must go on a long and expensive ocean voyage, or the city's chickens will come home to roost in the form of garbage-strewn beaches. As a matter of fact, on some of the ocean-front near the big city the volume of tidally deposited garbage is right now a serious problem.

In some cases the garbage is plowed under in fields as fertilizer. But the immediate value of garbage as fertilizer is far below what a chemical analysis might indicate because most of the plant food present is not immediately available as such. It must first go through a long process of decay. And then, if the garbage contains much grease, this may clog up the pores of the soil with the effect of stopping the free circulation of air and water, and thus the garbage may even become a detriment to the soil.

Incineration is one of the oldest methods of garbage disposal, and in many respects one of the most promising. This hypothetical new Moses of the Garbage Can might well take a lesson from the Moses of old, for it is recorded that during the exodus from Egypt Moses ordered that all offensive and unclean waste be taken outside the camp and burned.

Moses, however, would have wondered at the modern incinerating plants which not only provide a sanitary method of garbage disposal, but by burning the garbage under boilers develop energy in excess of the needs of the plant. The amount of energy available is not great because most of the steam thus generated must be used to dry the garbage before it can be burned. However, steam from such a plant operates a pumping plant for the city of Milwaukee, and the city of Savannah pumps part of its water supply in this manner. There is at least one small installation where this excess steam is turned into electric energy.

The chief difficulty with incineration is that the fumes from the burning garbage are likely to create a public nuisance. The city of New Bedford, Mass., recently had an experience of this sort. New Bedford until recently disposed of its garbage by reduction, but when the plant began losing large sums of money, an attempt was made to economize by installing a dryer so that garbage could be burned under the digester tank boilers. The fumes inspired such a protest from citizens that the plan was quickly abandoned.

Incinerating furnaces for the purpose of disposing of garbage with no idea of deriving therefrom any useful product or energy have been highly perfected. They consist usually of a coal fire beneath a grate on which the garbage is spread to dry, the dried material finally being fed into the fire and burned.

To the potential Moses of the garbage can, the writer has these suggestions as to methods of attacking the problem of economical garbage disposal:

1. Find some new use for garbage grease so that there will be a steady market for this product.

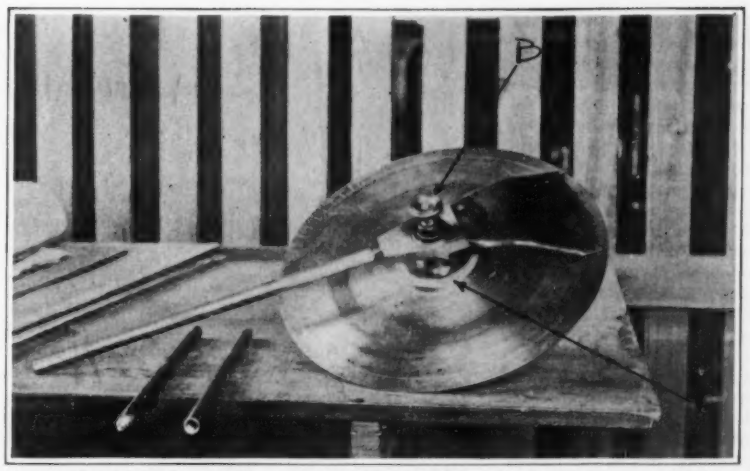
2. Find a method of overcoming the fumes from burning garbage so that the excess calorific value of garbage might be turned into useful energy without creating a nuisance.

3. And, failing in these, find a way to convince a most skeptical world that any method of garbage disposal not yet tried is worth trying.

Aerofoil Data

A RECENT paper of the National Advisory Committee for Aeronautics, "The Minimum Induced Drag of Aerofoils," by Max M. Munk, helps to explain the phenomenon of flight. It contains some theorems concerning the arrangement of airplane wings which are of considerable practical interest. In particular, it shows the theoretical reasons for the decrease of drag which accompanies all increase in the aspect ratio or lateral extension of a wing. The efficiency of a given arrangement of wings may be calculated from the formulæ in this paper.

A copy of this paper, which may be ordered as Report No. 121, may be obtained upon request from the National Advisory Committee for Aeronautics.



New timing disk for airplane motors; B and C are the thumbscrew and flange by means of which it is attached and operated

New Timing Disk Reduces a Day's Work into a Few Minutes

OBVIATING the removal and replacement of propellers, radiator shells and radiators, the labor-saving feature of a new timing disk designed and built by the engineering department of the United States Air Service at Post Flying Field, Fort Sill, Oklahoma, merits immediate recognition and widespread popularity. Specifically, the instrument was invented for use on Liberty motors, but by slight modifications it is adaptable on airplane engines of any design. The spindle of this disk is provided with tapers and an expansion feature, adjustable to fit into the hub of all Liberty motors.

The expansion of the spindle is possible by thumb screws. Freedom to revolve around the spindle is permitted the disk itself until the flange is screwed up, jamming the disk against the back flange, which is stationary on the spindle. Pointers are adjusted 45 degrees apart, indicating the center line of piston travel. Washers and nuts secure the indicator into position. Vertical position for the indicator is insured by a pendulum rod. For the sake of convenience, the indicator is cut into three sections and the ends are threaded so these will screw into another. It can be assembled in the absence of wrenches or tools. The disk is marked every 120 degrees, the notation being the point of top dead center, the crank shaft having three throws of 120 degrees. Valve and ignition timing is checked by calibrated degrees on each side of these 120-degree marks.

Instructions from the Air Service include specific directions for using this timing disk. The tail of the ship is raised, not an absolute requirement, but one giving the pendulum of the instrument full action. The spindle is shoved into the hole of the propeller hub, the adjustable screw being turned until a tight fit is insured. Forthwith the thumbscrew is relieved and the flange is screwed back, thereby permitting the disk to circumvent the spindle. The removal of at least one spark plug from each cylinder facilitates turning of the propeller. The top dead center of a cylinder, say, No. 6, is then discovered by inserting a pencil or scale into the spark-plug hole and turning the propeller until the piston, by upward stroke, touches the pencil or scale and causes it to ride up. Continue to turn the engine over slowly until the piston, as directed by pencil or scale, stops moving upward and is about to start downward—marking this point on the pencil. Approximate top dead center is thus vouchsafed.

The propeller is now turned over in a forward direction until the pencil or scale has moved down so that the mark is even with the top edge of the hole, using the pencil in marking the disk in line with one of the pointers. The engine is given a backward motion until the pencil has moved up and down until the mark is again even with the spark plug hole, the disk being marked in line with the pointer. A pair of dividers will reveal the point between the two pencil marks on the disk. Such point denotes the exact dead center of Nos. 1 and 6 cranks, the propeller being turned until the point just discovered is under the right pointer. Without moving the propeller, the flange is loosened as well as thumbscrews, and the disk is turned by hand until one of the 120-degree marks coincides with the pointer. Screw down the flange and thumbscrews and actual operation is in order. Subsequently, all the knowledge essential in timing the motor is that of recognizing when the valves open and close with reference to top and bottom dead center. Once having timed the motor, the disk is subject to removal by loosening the expansion screw and extracting the spindle from the propeller hub. Former designs of timing disks involved a day's labor, whereas the recent invention accomplishes an equal task within a few minutes.

Elevator Interlocks

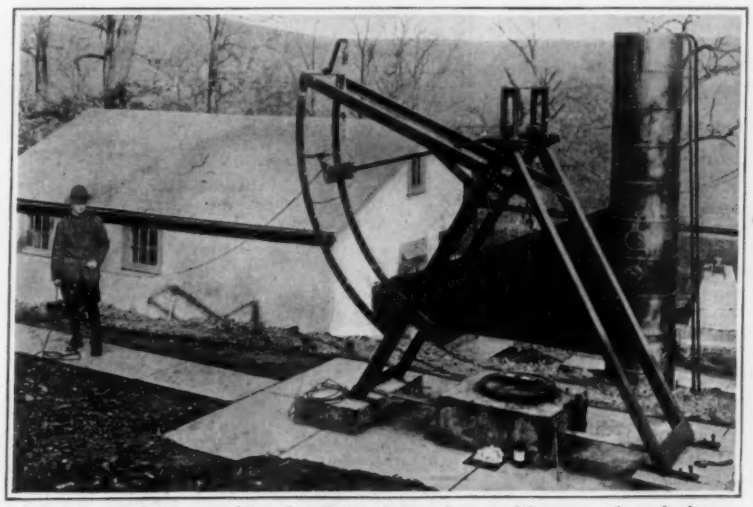
IN connection with the safety work of the Bureau of Standards, a survey has been made of many elevators located in several large cities with an idea of analyzing elevator accident statistics as bearing upon the use of safety interlocks. It has been shown that 73.8 per cent of all fatal accidents in connection with elevators which have doors to the shafts could be eliminated by the use of well-designed interlocks. The report has been prepared in the form of Technologic Paper No. 202 of the Bureau of Standards, Washington, D. C.

How Sensitive Is Dynamite?

MINING coal—hazardous occupation that it is—involves the use of explosives in tunneling for the winter's fuel supply. Frequently a cartridge of explosive becomes lodged in a drill hole and in forcing the charge of nitroglycerin or other form of dynamite to the base of the opening, ramming may be resorted to, an exigency that is likely to result in premature combustion unless the frictional resistance of the particular explosive is known. Such advance knowledge may now be ascertained by consulting a machine designed by the United States Bureau of Mines and adapted for use at its explosive experiment station near Bruceton, Pa.

A shoe, a pendulum, and an anvil are the three essential parts of the apparatus which lend themselves to easy introduction to the layman in a new guise. The swinging steel shoe, which may be shod with hardwood fiber or a product of more forceful impact, exerts itself in a pendulum-like fashion from varying heights on a steel anvil which contains and exposes the charge of explosive. Smooth-faced, like the anvil of the immortal village blacksmith, to the extent of having a surface 3½ inches wide and 12 inches long, in the middle are to be found three grooves for holding the object of the test. The steel shoe has a sway—that is, a radius of swing—of 6 feet 6¾ inches and the curvature of its beardless face is 10½ inches. Weights ranging from 2.2 to 44 pounds are employed in varying the force of the blow, the shoe being dropped from heights of 19.7 to 78.7 inches. Some explosives have yielded to the impact of the shoe when shod with wood fiber, while other combustible material is less sensitive even when pounded with harder substances.

Explosives recognized for use in mines, according to the 1920 permissible list of the Bureau of Mines, number 179 as compared with 162 in 1919. Thirty-four new explosives were admitted on the approved schedule, while 17 previously sanctioned were stricken from the list. A digest of the rules, regulations, and practices governing the testing of explosives has been prepared, and all may obtain the report upon application to the Pittsburgh Experiment Station of the Bureau of Mines, Pittsburgh, Pa.



Pendulum friction machine for determining the sensitiveness of explosives

New York's Proposed Be

Substituting Direct Rail Connection for Costly Car-Float and Ligh

By William J. Wilgu

COL. WILLIAM J. WILGUS, for many years chie Railroad, was responsible for the planning of the v France, which made possible the great effort of our Ex experience in the broad fields of railroad communication an special emphasis to the present article. Today, the transferr City yards to the consignee in New York costs as much as it five hundred miles or more inland. These conditions affect t the port of New York but of practically every city throughou

THE problems of New York are of more than local concern; they are of grave moment to the entire nation of which this port is the leading gateway to the markets of the world. Evils in its midst clog the free movement of traffic, place a burden of waste and delay on the country's foreign and coastwise commerce and seriously handicap the interior states in their struggle to dispose of their products at home and abroad. Moreover, whatever tends to block this portal also injures its efficiency as a means of national offense and defense in time of war, and adds to the expense of operation of the rail and water carriers in which the country is so deeply involved.

That such evils do exist is an acknowledged fact. As far back as 1900, Theodore Roosevelt, then Governor of the State of New York, recommended that prompt action be taken to remedy them, and several years later one of the Interstate Commerce Commissioners referred to the port as "the sore spot of the nation." It took the World War, however, to convince the public generally that something must be done to cure them.

The reason why these faults have been permitted to grow until they are a menace to the future of the port, is not difficult to find. It is a clear case of neglect to keep in pace with progress in the art of transportation. For more than two centuries its location on an island in the midst of a magnificent natural harbor, and at the mouth of a great river that penetrated the hinterland, was ideal for the sailing vessel and canal boat; but with the advent of the steam railroad that which was originally an advantage gradually became a positive detriment to trade with the interior. Railroads from the south and west came to the water's edge and found a barrier that could only be passed by transferring their loads to water craft and then retransferring them to land on the other side. It was not practicable to lay the car alongside the ship, nor uninterruptedly to move the car to its final destination. All this entailed additional switching of cars and "break of bulk" with their attendant use of valuable waterfront lands and the employment of lighters and car-floats for completing the rail haul. In consequence, piers for ocean-going vessels, then of comparatively small size, were built on Manhattan Island without provisions for tracks, and of dimensions utterly unfitted for economical operation of the modern steamship.

In the earlier years of the new era of transportation this was not found to be a serious disadvantage; but conditions changed with the enormous growth of traffic and the marked increase in the size of ships. Some 75,000,000 tons of railroad freight now pass to, from and through the port each year, and in so doing must cross the congested surface of the waters that separate the various parts of the city from each other and from the mainland on the west.

The wastefulness of this process can be best illustrated by comparing it with the confusion, delays and excessive costs that would reign in a great railroad terminal, where different gages of the main line and yard tracks would necessitate the transferring of car contents and car bodies in transit, within sight of their final destination, a condition too absurd for serious consideration.

Another development has accentuated these evils, namely, the phenomenal industrial and commercial growth of the New Jersey shore, brought about by the presence of the railroad terminals on that side of the water. What once affected the City of New York alone, now is a matter of the utmost concern to the two states, whose dividing line is the middle of the Hudson River and the Kills, from the southern tip of Staten Island to the northern limits of The Bronx.

Thus it will be seen that with the mutations of time three elements have conspired to threaten the continued preeminence of the port of New York:

(1) The apathy of its citizens who, like the fabled hare, have not realized that in greatness lurks the seed of its own decay—an o'erweening confidence in the maintenance of supremacy without effort;

(2) The presence of a physical barrier of the first magnitude between the rail termini on the New Jersey mainland and the island city of New York; and

(3) The existence of the boundary between the states which politically separate the two parts of a common port.

Of these the first and last are the hardest to overcome.

Happily, the outlook is bright for remedying these evils, provided words are promptly and effectively translated into action. For instance, there is widespread recognition of the need for reform if New York is to hold her own in competition with rival routes, including the proposed Great Lakes—St. Lawrence ship canal project. Also, the two states are uniting in the building of a unique twin-bore tunnel beneath the North River, for affording vehicular access between lower Manhattan and Jersey City. Furthermore, laws have been enacted by the two states creating a port authority for the unified improvement and administration of the port as a whole, which, suitably amended in the future, should accomplish its high purpose. Finally, a New York State law has been passed which directs the City, within two years, to start the construction of a freight and passenger tunnel under The Narrows between the boroughs of Brooklyn and Richmond (Staten Island), the rental for which shall be sufficient to pay interest charges and amortization.

It is with the last mentioned project that this article has principally to do, as the requirement that the tunnel shall be self-supporting has forced the City to look beyond its borders for prospective users—the railroads that serve the port—all of whom, it is believed, may be brought to the portals of the tunnel if it can be shown to them that the advantages of so doing will warrant their uniting in the building of a Metropolitan Belt Railway that will put them all in direct rail communication with each other and with all five boroughs of the city.

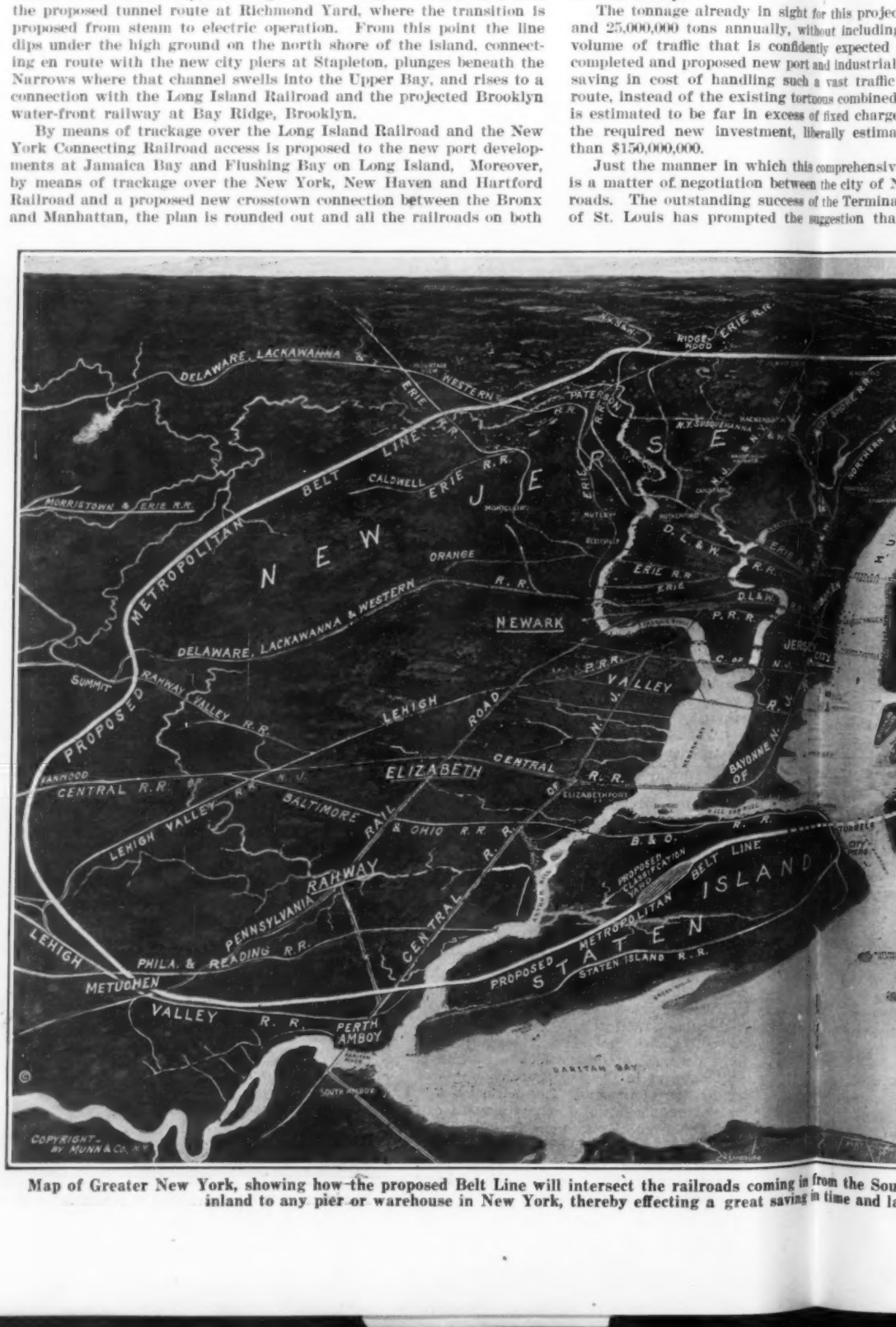
It will at once be seen that a facility of this kind will by-pass a large proportion of the enormous tonnage that now wends its painful course through the congested heart of the port, and thereby obviate many of the evils to which reference has been made.

With this object in view a tentative location has been selected for a modern double-track easy grade railroad, which leaves the West Shore Railroad near Haworth in the rear of the Palisades, and runs thence west to the vicinity of Paterson; thence bends south and follows the rural valley of the Passaic River; thence turns east and tunnels through the Orange Mountains at Short Hills; thence again curves to the south and skirts the easterly foot of the mountain escarpment as far as Scotch Plains; thence takes a southeasterly course through South Plainfield and Metuchen to Perth Amboy, where Arthur Kills is crossed on a high level viaduct with ample clearances for ocean-going vessels; and thence northeasterly, bisecting Staten Island, to a connection with the proposed tunnel route at Richmond Yard, where the transition is proposed from steam to electric operation. From this point the line dips under the high ground on the north shore of the island, connecting en route with the new city piers at Stapleton, plunges beneath the Narrows where that channel swells into the Upper Bay, and rises to a connection with the Long Island Railroad and the projected Brooklyn water-front railway at Bay Ridge, Brooklyn.

By means of trackage over the Long Island Railroad and the New York Connecting Railroad access is proposed to the new port developments at Jamaica Bay and Flushing Bay on Long Island. Moreover, by means of trackage over the New York, New Haven and Hartford Railroad and a proposed new crosstown connection between the Bronx and Manhattan, the plan is rounded out and all the railroads on both sides of the state boundary are brought into other and with existing and proposed future i boroughs of the city of New York and in the gr of New Jersey.

The tonnage already in sight for this proje and 25,000,000 tons annually, without includin volume of traffic that is confidently expected completed and proposed new port and industrial saving in cost of handling such a vast traffic route, instead of the existing tortuous combined is estimated to be far in excess of fixed charg the required new investment, liberally estima than $150,000,000.

Just the manner in which this comprehensiv is a matter of negotiation between the city of N roads. The outstanding success of the Termina of St. Louis has prompted the suggestion tha



Map of Greater New York, showing how the proposed Belt Line will intersect the railroads coming in from the Sou inland to any pier or warehouse in New York, thereby effecting a great saving in time and la

posed Belt Railway

Float and Lighter Transfer Between Rail, Warehouse and Dock

William J. Wilgus

or many years chief engineer of the New York Central planning of the vast system of docks and railroads in eat effort of our Expeditionary Army in 1918. His long communication and terminal and dock facilities gives oday, the transferring of a car of freight from the Jersey costs as much as it does to bring that freight from points e conditions affect the interests of the people, not only of every city throughout the United States.—EDITOR.

y are brought into rail contact with each l proposed future improvements in all five York and in the growing industrial regions

sight for this project is between 20,000,000 y, without including the anticipated great onfidently expected to flow from partially port and industrial facilities. The annual such a vast traffic by this direct all-rail g tortuous combined rail and water routes, cess of fixed charges and amortization on nt, liberally estimated at something less

h this comprehensive plan may be realized etween the city of New York and the rail- cess of the Terminal Railroad Association the suggestion that a similar agreement should be made between all the railroads of the port, under which they would jointly construct the portion of the proposed railway that lies in New Jersey, jointly lease the sections that are within the limits of the metropolis, and afford service to the users of such joint facilities at rates that will guarantee the payment of operating expenses and fixed charges, and no more.

The experience of other ports and important commercial centers is in harmony with the claims that are made in behalf of the plan here set forth. Montreal, Philadelphia, Baltimore, New Orleans, San Francisco and Chicago, as well as St. Louis, all voice the decided opinion that the belt railway is the backbone of their transportation layout, and essential to their success.

So there appears to be every reason why the railroads should unite with the city of New York in taking advantage of the Narrows tunnel act to remedy many of the evils from which the greatest port in the world is suffering by reason of its physical disabilities. The careful detail analysis that has been made of the proposed belt railway demonstrates that the project will much more than pay its way out of savings, and in addition bring many priceless benefits to a variety of interests.

The port as a whole, including the railroads that serve it, will profit from the removal of abuses that threaten to divert trade to rival routes; the city of New York, in all its boroughs, will enjoy the advantage, now denied it, of direct rail contact with all the railroads of the port, with resultant stimulation of dormant areas, appreciation of property values, growth of trade and commerce, and lessened congestion, delays and cost in connection with the supply of food and fuel.

ing in from the South and West. This will render it possible to run a carload of freight direct from points aving in time and labor over the present system of transfer by car-float and lighter

The commercial, manufacturing and shipping interests will gain through better liaison between the car and the facility it serves; and the federal Government will secure improved prospects of modern terminals for its merchant marine, the surety of more economical operation of the railroads in which it is vitally concerned, and a valuable factor in defense of the city and nation in time of war.

Too much emphasis can not be laid on the last item. During the World War it is a matter of common knowledge that Paris, and therefore the allied cause, was saved on several occasions through the presence of the Grande Ceinture (Outer Belt) over which troops and supplies were poured from many directions to crucial points without having to pass through congested centers. Certainly we do not wish again to find ourselves some day in Washington's predicament when he lost the Battle of Long Island in 1776. Our national safety demands that means should be provided, without delay, whereby for *defensive* purposes a modern army with its supplies may be quickly drawn from many points in the interior and concentrated on Long Island or on the north shore of Long Island Sound. These same means, in the case of *offensive* operations, will spare us from the possibility of disaster which came so near to us when the existing facilities at New York broke down during the late war.

Certainly the need for this great engineering work is urgent in the extreme, and calls for effective action by all the interests named in support of the start that has been so promptly made by the city of New York in compliance with the mandate of the State.

Studying the Flight of Flies

THE marking and release of 234,000 flies by expert Government entomologists in order that these scientists might study in detail peculiarities in fly behavior which previously had never been investigated thoroughly is one of the most remarkable undertakings and accomplishments of recent years so far as "bugologists" are concerned. Federal representatives of the National Bureau of Entomology have officiated as modern fly cops and insect detectives in these novel experiments, whose objects have been to determine how various species of economic insects were distributed and how knowledge concerning the intimate daily doings of the winged pests could be used advantageously in developing efficacious control and eradication measures. The varieties of flies which affect man and animals are largely distributed by natural dispersion through ordinary flight.

These unique fly tests were started in order that practical data might be had which could be interpreted in terms of the spread of fly-borne diseases as well as to provide accurate data regarding the proper location of dumps, incinerators, hog feeding stations and other favorable fly breeding grounds, so that the menace to surrounding towns, cities and rural districts would be avoided. House flies may travel anywhere from one mile to 50, or even 100 miles, in their journeyings about. Observations made at the Rebecca Light Shoal off the coast of Florida show that flies occasionally migrate to that point from Cuba, a distance of 95 miles, while fly visitors from Key West, only 46 miles away, are relatively common.

The federal fly investigations have been carried on chiefly in northern Texas. The flies were captured by baiting large conical fly traps with packing house products of strong odor. The traps were exposed in places which teemed with flies for anywhere from 4 to 24 hours and then screened cylinders were placed around the fly traps, the covers of the traps were removed, and then they were agitated until the flies were driven into the cylinders. The free ends of the cylinders were then covered with cheesecloth and they were conveyed expeditiously to the point of liberation, where the cylinders, one at a time, were slipped into a special canvas bag containing one or two ounces of finely powdered red chalk or paint pigment, which was thoroughly sprinkled over the captive flies so as to mark them definitely for future identification. The flies were then liberated. Yellow chalk and rosalic acid were not satisfactory for marking the flies, red chalk and red pigment being the best materials for this purpose.

The flies flew away immediately after release from their paint-box prisons, most of them speeding with the wind or at right angles to its course. In order to ascertain the distance of dissemination, a large number of conical traps 18 inches in diameter were placed at varying distances in different directions from the points of liberation. These traps were baited with strong-smelling by-products which would attract the flies. The flies collected in these recovery traps were killed daily and counted, and the number of marked flies determined. In case the coloring matter could not be seen with the naked eye, microscopes were used which invariably would favor the identification of all the experimental flies in each lot. It is notable that over 64 per cent of the total number of marked flies recovered were captured again within 24 hours after liberation. Most of these flies previous to capture traveled at right angles to a wind that was traveling at a velocity of from 13 to 24 miles an hour. These experimental results show that for some unexplained reason the flies of all species failed to be recovered in the traps south of the points of liberation in numbers in proportion to those recaptured in the traps placed in the other directions. These tests also showed that the flies travel with a fair degree of speed, as they cover the first 1000 feet from their place of release in a few minutes. The common house fly will cover from 5 to 9 miles about two days immediately after release. The tendency of the flies was to travel in a westerly direction, 77 per cent of them being recaptured in traps placed in that direction.

The stimuli which was largely responsible for the wide dispersion of the house flies were the desire for food and the desire for places where eggs could be deposited. The fact that in their flights the house flies passed many towns, farms and other favorable places for feeding and breeding indicates that they possess marked migratory habits.

Lessening Lumber Losses

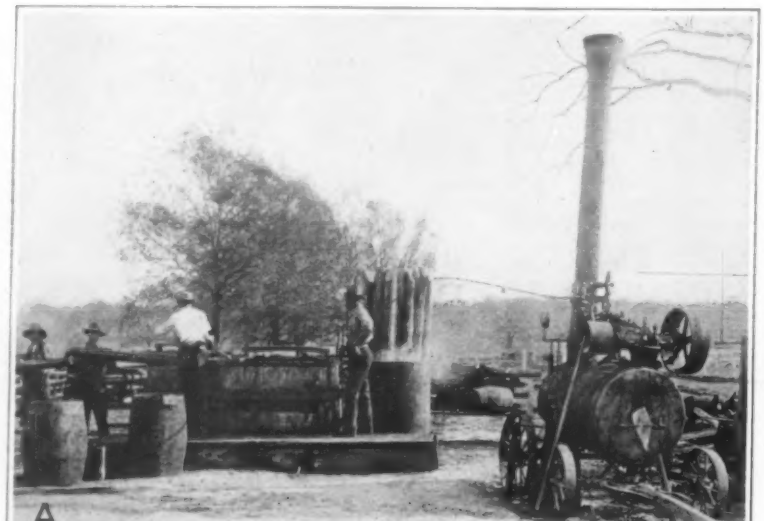
Some of the Ways in Which Wood Wastes Are Saved and Put to Work

By George H. Dacy

THERE are two ways, and only two, in which we can continue to meet our wood requirements, says Uncle Sam. One of these is to grow more wood; the other alternative is to use more effectively the supplies now available. We must see that our remaining 137,000,000 acres of virgin forests are cut in such a way as to maintain the productivity of the land, and that our 81,000,000 acres of wholly idle, and our 235,000,000 acres of partially idle forest lands are put to work. Furthermore we must see that, of the 24 billion cubic feet removed from the forests each year, 70 to 75 per cent no longer goes to waste in the form of sawdust, shavings, and other mill refuse—that more than 25 to 30 per cent is put to some use.

It is only during the last few years that any great amount of technical and scientific study has been devoted to wood in this country. Thousands of experts previously had devoted their energies to the solution of problems related to steel, concrete, oil and rubber industries, but wood which was more complex and intricate than any of these was neglected. Hence about a decade ago Uncle Sam and his skilful foresters, appreciating the vital need for more knowledge about wood, plunged into the task of research and investigative work in search of knowledge nuggets which would permit of our more efficient utilization of our timber supplies. The results are that more than a half million tests have been made on 140 different kinds of native woods at the federal Forest Products Laboratory at Madison, Wisconsin. These make it possible to substitute accurate facts and figures for previous guesswork in utilizing wood for the thousand and one purposes for which its strength, elasticity, toughness and other mechanical properties adapt it. In some cases this means merely finding a use for something always heretofore discarded; in others it involves actual new processes of treatment extending the use of a particular variety of wood.

Grading rules for the building trades have been worked out as a result of experiments on the strength of southern yellow pine and Douglas fir which now make it possible to secure as great structural strength in construction by the use of 20 per cent less material than was formerly employed. This discovery alone means a saving of about $40,000,000, if all contractors will practice it. Formerly, untold millions of feet of valuable hickory have been wasted because the handle and spoke manufacturers have assumed erroneously that the red heartwood was inferior to the white sapwood. Government tests have demonstrated the error of this assumption and have effected great savings in the hickory industry.



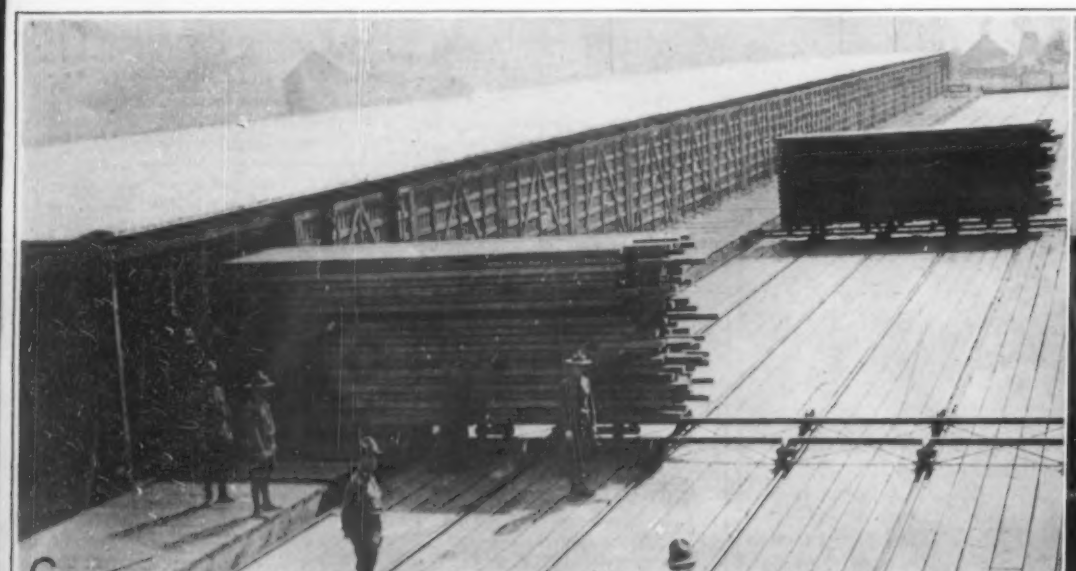
Creosoting posts, poles and railroad ties to prevent decay

Heretofore, time and money have been wasted in drying and seasoning green lumber by natural air exposure methods. The federal foresters have speeded up these long-drawn-out natural processes of curing by the mechanical use of dry kilns, and now more than 35 different kinds of woods such as Douglas fir, spruce, southern yellow pine, gum and oak can be dried in short periods at low cost. An annual saving of more than $5,000,000 has already been effected despite that the use of the new methods is still infantile in extent as measured in terms of the countrywide industry. For example, it used to take one to two years of air drying to season Douglas fir so that it was adapted for certain manufacturing uses. Now this work can be accomplished under kiln drying systems in one-month. In other industries, kiln drying has reduced the loss of material from 60 per cent to less than 2 per cent, while shortening the seasoning period at least 40 per cent.

A heavy call on our available forest stocks is made annually in the replacement of decayed railroad ties, mine and bridge timbers, poles, posts, piling and other wooden material of large sizes exposed to constant weathering. There are now more than 85,000,000 railroad ties in use in this country which have not been treated with protective overcoatings of creosote, zinc chloride, or other suitable preservatives in order to protect them against decay. Forest Service tests show that untreated crossties only last an average of 7.5 years, whereas treated ties are serviceable for 15 years or longer. If all railroad ties used in this country were annually treated in this manner—the cost per tie is not large—a saving of more than 1,500,000,000 board feet of valuable hardwood lumber would result. If all wood used in the United States which is exposed to decay were similarly armored, the annual saving would aggregate over 6,000,000,000 board feet, equivalent to 20 per cent of our annual lumber cut. This would go a long way toward saving our forests.

About 15 per cent of the annual lumber cut is now used in making boxes and crates, the bulk of which are unsatisfactory in shape, size or strength. The National Forest Service has devised efficient testing methods and systems of standardizing these containers so that a good many millions of dollars worth of freight will be rescued from repetitions of previous disasters during transit, while large amounts of lumber which previously have been wasted—so far as satisfactory container service was concerned—will be saved. During a recent year, our domestic railroads paid out over $100,000,000 for freight lost and damaged during shipment due to faulty boxes and crates. White pine alone formerly was used largely for containers, but now as a result of government experiments, 40 different kinds of wood are used, many of which are thinner and stronger and reduce car and cargo space from 10 to 40 per cent—to say nothing of the direct economy of material.

As a result of the prevalent practice of cutting small dimension material from finished lumber instead of from the logs, large wastes occur in the handle, spoke, chair, furniture, toy and agricultural implement industries. In the furniture business, from 40 to 60 per cent of the raw lumber is frequently wasted. Some hickory handle factories report that not infrequently it takes two tons of lumber to produce 400 pounds of satisfactory handles. Experts say that a saving of about 6,000,000,000 board feet a year can be effected if only all the lumber which is now wasted by the industries could be saved and used as small dimension stock.



Left: Douglas fir wing-beams for airplanes being kiln dried and seasoned in thirty days, against two years required by old processes. *Right:* Pickling posts in creosote to protect them from the ravages of insect pests

Making our supply of wood stretch out further than in the past

The potentialities presented by the perfection of built-up methods of construction—discovered and improved by the U. S. Forest Service—indicate one practical means of plugging the largest leak in the field of wood utilization. The history of the average saw log is prolific in tales of waste from the time the tree is felled. Mr. S. T. Dana, prominent forest economist, says in this regard: "Of the wood in the forest, some 25 per cent is now lost in the woods, 40 per cent at the mill, 5 per cent in seasoning and from 5 to 10 per cent in converting the raw lumber into the finished product. Moreover, the replacement of our magnificent virgin forests by small-sized, poorly formed, often defective second-growth trees is making it increasingly difficult to secure high grade material. The problem is to ascertain some way of utilizing the 75 per cent now wasted and of making the low-grade material from our inferior second-growth forests do the work for which high-grade material has heretofore been regarded as indispensable. Built-up construction, by making possible the use of cuts and ends from low-grade lumber, slabs, edgings and other material now wasted may furnish the answer. One of the striking features about built-up products is that if properly made they are not only fully as serviceable as similar articles made of solid wood, but that the glued joints are ordinarily stronger than the wood itself. Their chief weakness rests in the fact that when they are constantly immersed in water or subjected to alternate drying and wetting, they must be made of waterproof glue, a material which does not yet exist."

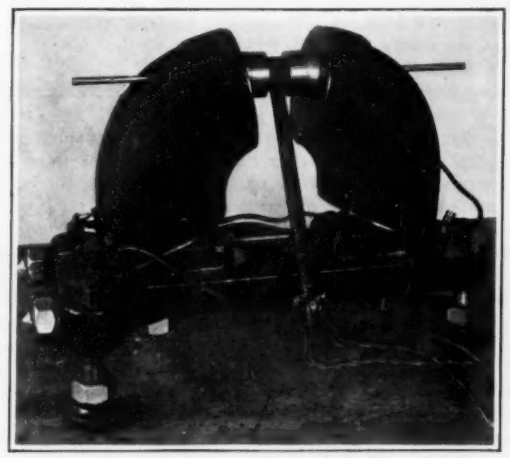
Wood is the most wonderful material in the world if the diversity of products emanating from it is any basis for judgment. Products derived from wood are now being employed in the manufacture of news and writing paper, linoleum, artificial silk, gunpowder, paints, varnishes, soaps, inks, celluloid, sausage casings, acetylene, chloroform and iodoform. Again the writer quotes Mr. Dana, who told him that 90 per cent of our paper supply is now made from wood: "The paper industry employs 110,000 persons, has an annual output valued at $850,000,000, and consumes each year over 6,000,000 cords of wood, the product of more than 1,000,000 acres of forest. Over 60 per cent of this is spruce, and the majority of the remainder hemlock, balsam and poplar. In the wrapping paper field, methods for utilizing the southern yellow pines, hitherto regarded as unsuitable for the commercial production of paper pulp, have been developed and the industry established. One of the largest lumber companies in the South is now turning its woods and mill waste into paper pulp at the rate of 60 tons a day. Recently marked progress has been made in working out methods to enable the use of southern pines, such as shortleaf, in mixture with hardwoods such as red gum for the production of book paper, and already these methods have been introduced into one extensive mill."

Studies are now under way under the direction of the U. S. Forest Service designed to consummate the potential salvage of material worth more than $16,000,000 now lost each year through the decay of pulp wood and wood pulp while in storage. Another avenue which promises partly to cork up the annual drain on our forests for wood pulp emanates from the use of hull fiber and second-cut cotton linters and their utilization for paper pulp purposes. Experiments have shown that these materials, of which there are about 200,000 tons available each year, can be converted into high grade paper. Several large plants are now engaged in this work, their daily production amounting to 300 tons with a sale value of $15,000,000.

Wood alcohol which is indispensable in several chemical industries is made by the destructive distillation of wood. Acetate of lime also obtains from the process and gives rise to the production of acetic acid, acetone, acetic ether and similar materials. Small and crooked trees, limb wood and slabs are used for the production of wood alcohol whose manufacture furnishes a profitable disposition for these misfits of the timber tract. The by-product of the distillation consists of charcoal which is used as a fuel as well as in the smelting of iron, tin and copper, in the manufacture of gunpowder, as an insulating material, and as a clarifier in sugar refineries.

Formerly birch, beech and maple were considered as the only satisfactory woods for the making of wood alcohol, but recent investigations have demonstrated that oak, gum, elm, ash and hickory are just as efficient for this purpose. The methods of distillation have now been greatly improved and the amount of alcohol obtained from a given amount of wood has been increased from 10 to 15 per cent by better control of the temperature and the use of less fuel. Fifty per cent increased yields of alcohol have recently resulted by adding sodium carbonate in the form of chips or sawdust briquettes to the wood.

Mechanical glue-spreader used in the manufacture of plywood



New apparatus for studying steel under the influence of an intense magnetic field

The naval-stores industry can be saved only by perpetuating our forests, but it can be prolonged by devising methods of tapping which will give larger yields with less injury to the trees. A new system of tapping developed by the Forest Service experts has already effected a saving of more than $4,000,000 a year. Under this system, 20 per cent more gum can be obtained, the deterioration of the timber is much less and the danger from fire is greatly decreased. Potentially, it is anticipated that present methods will be so modified that the lives of the trees will be greatly prolonged.

Sawdust and mill wastes can now be used on a practical scale in the manufacture of grain alcohol, the sawdust being hydrolized by treatment with a weak acid and then cooked so that its cellulose is converted into sugar. Yeast is then added, which ferments the sugar and finally produces alcohol which can be separated from the rest of the solution by distillation. One ton of dry, coniferous wood like Douglas fir or southern yellow pine will yield from 20 to 25 gallons of 95 per cent alcohol. Chemists and foresters predict that shortly grain alcohol will be one of our important motor fuels. Already some resort to this ethyl alcohol for motor fuel has been made as our gasoline supply decreases. It is estimated that more than 300,000,000 gallons of this alcohol could be made from the wood material now wasted annually at American mills. Small trees and low grade material could also be devoted to this use. It may be that the time will come when trees will be grown in planted forests for the specialized production of grain alcohol for use in automobiles. This would be but the logical outgrowth of the day's advances in chemical technology.

Magnetic Testing of Wider Applicability

THE flaming forge of the village blacksmith shapes the piece of steel in response to the needs of the moment. Nobody doubts the pliableness of the metal when subjected to intense heat, but probably few reason that the specimen of steel undergoes marked changes in character while the hot flames are being applied. All by way of suggesting that steel is an interesting subject for study and that scientists have not said the last word on metallurgy.

The development of new apparatus by the National Bureau of Standards lends emphasis to the theoretical study of steel under the influences of intense magnetic fields. Its accommodations for making magnetic measurements of relatively long straight bars of iron or steel in intense fields is the distinguishing characteristic of this device as compared with other similar apparatus. The projecting bars evident in the illustration reproduced herewith emphasize this novel virtue. Heretofore the length of the test specimen was restricted by the testing mechanism itself. By the use of this apparatus it is possible to carry the magnetizing force to a sufficient degree to determine the saturation intensity of magnetization of long bars.

The apparatus is composed of an electromagnet of the Du Bois type with flat pole pieces. These are separated by an air gap of 2 centimeters and pierced coaxially so that a rod 6 millimeters in diameter and several centimeters long can be extended through them as well as the electromagnet. The test specimen is surrounded by three coaxial coils wound on brass forms, each 1 centimeter long and having external diameters of 7 millimeters, 10.5 millimeters, and 13.2 millimeters, respectively. Each coil has 100 turns of No. 40 enameled copper wire. Insulation from the brass forms is guaranteed by the enclosing of the latter in a thin sheet of paper; reinforced by having the whole coil, after winding, shellacked and baked in an oven at 100 deg. Centigrade for several hours.

This apparatus should prove useful in applying magnetic analysis in the theoretical study of iron and steel. The device will not displace other serviceable apparatus, but constitute an additional method for studying the physical properties of steel. The Bureau of Standards is now engaged in studying the correlation between the magnetic and mechanical properties of steel.—*By S. R. Winters.*

Investigating the chemical basis of tanning in the world's smallest tannery

A Tiny Tannery

THE world's smallest complete tannery has recently been constructed by Prof. A. W. Thomas of Columbia University, New York. Barely two and one-half feet long, raw hides can be fully and most scientifically tanned in this invention. Professor Thomas built this tiny tannery, which is believed to be the only one of its kind in the world, with the object of making a careful and scientific study of the fundamental chemical action of tanning; in other words, to find out just why certain chemicals acting upon the raw hide tan it into serviceable leather. Curiously enough, although the process of tanning has been understood for generations, we have yet to learn the chemical why of it.

The Latest in Steel Rails

Doubling the Life While Increasing the Cost Only by Twenty Per Cent

By Frederic C. Carl

OBSERVANT strollers upon that favorite American promenade, the railroad track, may see on the web of an occasional rail, in addition to the usual other cabalistic letters, figures and signs, the raised letters "S S S," near one end. These letters are the initials of the words "Sandberg Sorbitic Steel," a material now engrossing the interest of railroad managements, metallurgists and manufacturers in Europe and America.

Five hundred tons of sorbitic steel rails, weighing 105 pounds to the yard, or enough to lay three miles of continuous track, have been laid since last February on the Spuyten Duyvil curve in the electric zone, and in numerous other curves, on the Hudson River and the Pennsylvania divisions of the New York Central Railroad. In each instance, in accordance with the request of the manufacturers, the outer rail for one half the curve is sorbitic steel and for the other half of ordinary open-hearth steel: this in order that comparisons may be made under identical conditions in numerous instances.

Representatives of the railroad and of the licensees under the Sandberg patents keep these rails under observation. Contours of the rail heads are taken at intervals of three to six months. From the amount of metal worn the life of the rails can be determined and the relative merits of the new and old processes compared.

At least two years will be required to reach definite conclusions; but experiments begun at a prior date on other American railroads seem to bear out the assertion that sorbitic steel will wear from two to three times as long as ordinary open hearth steel rolled at the same time from the same ingot. With open hearth rails at $47 a ton, an additional charge of $9 a ton is made for the Sandberg process. An extra wear of 100 per cent or more for an increased price of 19 per cent would seem to be a most attractive bargain for frugal railroads.

In December, 1917, the Pennsylvania Railroad purchased an experimental lot of 130 pound rails made by the new process. Some of them were laid in 3- and 4-degree curves on Turkey Hill, where they were subjected to a slow-freight traffic aggregating 127,000,000 tons in two years. Numerous other American railroads, including the Lehigh Valley, Delaware & Hudson, Delaware, Lackawanna & Western, New York, New Haven & Hartford and Southern have ordered experimental lots of sorbitic steel rails varying in weight from 90 to 136 pounds to the yard. The accumulated data from all these trials ought to be conclusive.

The manufacturers have also supplied a lot of the new-process rails to the French State railways. In England, where the process originated, experiments with the Sandberg rail have been conducted for the last four years on several steam railroads and on more numerous street railways in the larger cities. The English are also experimenting with the Sandberg process for hardening what they insist on calling "tyres."

During the war an offer of the Sandberg process as a free gift to the British Government was accepted after exhaustive experiments by the Ordnance Committee, and the process was adopted by the Ministry of Munitions for the purpose of reclaiming high-explosive-shell steel which failed to meet specifications. The process was used extensively in England, Canada and the United States for this purpose, saving several million shell forgings which otherwise would have been rejected. In this way the Sandberg process was brought to the favorable attention of the corporation which obtained the right to use it in the United States.

The process is the invention of C. P. Sandberg, a distinguished British metallurgist now deceased, developed commercially in response to an increasingly urgent demand for rails of a higher quality. It is well known that committees of the American Society of Civil Engineers, the American Railway Engineering Association, the American Society for Testing Materials, not to mention the United States Bureau of Standards and a number of private investigators have been studying the rail problem for years. Section, chemical composition and details of manufacture from the open-hearth furnace to the cooling bed have been reported upon and argued about without limit and without satisfactory result; for every improvement in the rail has been promptly followed by an increase in the demands upon it.

Attempts have been made, both in England and the United States, to find a method of tempering rails economically; but the plan involved quenching the rail at a high temperature and then reheating to arrive at a given temperature. The process was slow, very expensive, difficult to control and uncertain in results. The New York Central has 1,500 tons of manganese steel rails in service. The Southern Pacific purchased 2,000 tons of manganese rails to lay in passenger tracks on mountain divisions. A number of other roads have also tried manganese rails on curves. Prior to the war the price ranged from $80 to $85 a ton; during the war the quotation went up to $250 to $280 a ton; now it is around $180.

Manganese rails are tempered by being quenched in water. It is agreed that they will wear ten times as long as open-hearth steel; but their elastic limit is only 35,000 pounds. Extra good wearing rails are not needed on tangents, but they are essential on curves. Rails of such low elastic limit, if hit by a locomotive at high speed not properly counterbalanced, might bend with unfortunate results.

An ideal method of manufacturing a rail which should at least satisfy present demands would not restrict the output, would not discard old plants or require elaborate new apparatus, would not unduly increase cost and would materially increase both safety and durability.

EVEN the layman whose interest in metallurgy prompts him to try to keep posted on this subject must have met the terms austenite, martensite, troostite, sorbite, pearlite, ferrite, cementite, and perhaps a few other -ites of one sort or another. Nobody, we believe, is entirely clear as to the hows and whys and wherefores, and particularly as to the precise whats, of these substances; but we are learning every day. And in the learning we are putting on a very solid basis of scientific knowledge a lot of things which have never before been understood at all, or known in any sense other than the empiric. The heat-treater knew by bitter experience that some things he must do and others he must not; he had no idea why. That great progress is being made in this essential department of engineering knowledge is evidenced by the fact that the makers of a new steel rail for which double life is claimed are sufficiently removed from the empirical to be able to christen their product "sorbitic." It is this sorbitic rail and its showing that Mr. Carl tells us of in the present story.—THE EDITOR.

The Sandberg process seems to meet all these requirements fully. The additional apparatus required is nothing more than a section of pipe the length of a standard rail, pierced with holes three-sixteenths of an inch in diameter and spaced three-eighths of an inch apart. As the rail comes from the hot saw, at a temperature of about 1,800 degrees Fahrenheit, at which the color is a deep orange, it is held close under this pipe while air at a pressure of 12 to 15 pounds plays upon the top and sides of the head for about three minutes, or until it has cooled down through the critical range to recalescence, when the temperature of the head is about 1,250 Fahrenheit. The rail then passes on to the cooling bed as usual. Two such pipes are sufficient to treat 20 per cent of the output of the big rolling mill at Steelton, near Harrisburg.

Steel in a sorbitic condition has long been known to give maximum hardness and strength combined with toughness, a high elastic limit and resistance to shock. A sorbitic structure is therefore aimed at in the metal for gun forgings and other high class work. Sandberg's contribution to the art was a practical method for treating rails to attain this structure.

The effect of the Sandberg treatment is to develop a sorbitic structure in the upper surface of the head of the rail to a depth of about three-eighths of an inch, although it is claimed that the sorbitic structure is carried to a depth of about an inch in some instances. Sorbitic granules are so very fine that it is difficult to distinguish them even when enlarged 1,000 diameters. Photomicrographs show a marked contrast to pearlite with its distinct markings, the sorbite being a perfectly smooth black. Hardness is very greatly increased without increased brittleness. On the contrary the Sandberg treatment renders the steel more ductile.

In one test a rail was cut in two, one half being left as rolled while the other half was given the Sandberg treatment. Pieces 8 inches long were machined from the heads of the two pieces, then fixed in a chuck for abrasion tests. After 2,000 revolutions per minute for 20 minutes the pieces were measured by micrometer. The untreated piece had worn away 1.35 millimeters; the sorbitic steel only .32 millimeter. Under a sliding abrasion test, the nearest approach to actual wear to which a rail is subjected in the track, sorbitic steel showed a resistance of three to one as compared with untreated steel. By the Brinell test the sorbitic part of a treated rail showed a hardness of 300 to 350 as compared with 240 in the pearlitic structure of the web and base of the same rail. Hardness by the scleroscopic test is 50 to 52 for sorbitic steel and 38 to 40 for ordinary open-hearth steel. Sorbitic steel has an elastic limit of 90,000 pounds and a tensile strength of 140,000 pounds with an elongation of eight per cent, as compared with 60,000 elastic limit, 125,000 pounds tensile strength and elongation of ten per cent for open-hearth steel.

Another form of the Sandberg treatment for producing a sorbitic condition in the upper surface of the heads of rails in place has recently been applied rather extensively on street railways in London, Bournemouth, Manchester, Birmingham, Liverpool and Glasgow. A four-wheeled push-car with hand gear for slow uniform movement, is fitted with a special acetylene burner for heating the head of the rail. When the proper temperature has been reached the head is cooled by a jet of water from a tank on the car.

Photomicrographs of drillings at various depths show a progressive change in the metal. At a depth of one-eight inch there is a sorbitic structure with a hardness of 600 on the Brinell scale; at a depth of three-sixteenths inch there is a change from sorbitic to pearlitic structure; at a depth of five-sixteenths inch normal pearlitic structure is found. The rails so treated become highly polished, showing the change in the structure. This process has the advantage of requiring no disturbance of the permanent way; but steam railroad men look askance at the mere suggestion of such heroic treatment.

Treatment by the Sandberg process at Steelton is such that the base and web of the rail are not affected. Only the wearing surface and the sides of the head are tempered because those are the only parts subjected to wear. The outer rail on curves is subjected to very severe wear for it has to resist the tangential thrust of the enormously heavy trains at high speed. The inner side of the head of the best open-hearth rail that the present state of the art can produce is soon badly worn and deformed, especially on a busy road like the Pennsylvania division of the New York Central Railroad with its traffic of 60,000,000 tons a year. As at present applied the Sandberg treatment does not harden the sides as much as the upper surface of the rail head, and to that extent improvement seems desirable.

As sorbitic steel rails at an increased price are wanted only for severe conditions on curves under heavy traffic, particular care is taken at Steelton to insure good material. Steel low in carbon is cast in very large ingots—25x30x96 inches, weighing 12,800 pounds. Then, to insure sound normal metal, the upper two rails from the ingot are discarded.

German Locomotives for Russia

AN article in the *Berliner Tageblatt*, dealing with the increasing activity in Russo-German trade, states that the Soviet Government recently ordered 700 railway engines, which German manufacturers have undertaken to deliver in six to seven months. The first cargo of six engines is already at Hamburg awaiting transport to Russia. The Soviet Government has also placed orders in Germany for chemicals, agricultural machinery and rails to the value of a milliard and a half marks. The first deliveries of goods in payment from Russia have already arrived in Germany.

A Camera That Analyzes Motion

MOST unusual effects can be obtained by taking motion pictures at a high rate of speed and projecting them at the standard speed of sixteen pictures, or "frames," per second. Such pictures show tennis balls and hurdling horses floating through the air, boxers gently and nonchalantly fanning and tapping each other, and so on. There are various special cameras for this kind of work—high-speed filming—but until the present their construction has been considered the deepest secret.

A new speed camera for motion-picture work, designed to overcome the objectionable features of the makeshift devices heretofore used for this work, has been invented by a Pacific Coast man. The chief characteristic of the new camera is a straight pull on the film. With a camera capable of taking 14 feet of film (224 separate pictures or frames) per second, it will be readily appreciated that there is a terrific strain on the film, to say nothing of similar destructive influence on the camera itself.

With the film magazines mounted at the back, the new camera takes the film in a direct line to the aperture and in another direct line back to the take-up magazine, thus providing an instrument that has only one turn for the film.

With a turning mechanism that is geared very high, each turn of the handle exposes seven feet of film. The handle is turned at the same rate as on an ordinary camera—two turns per second—hence to the operator there is no difference in manipulation.

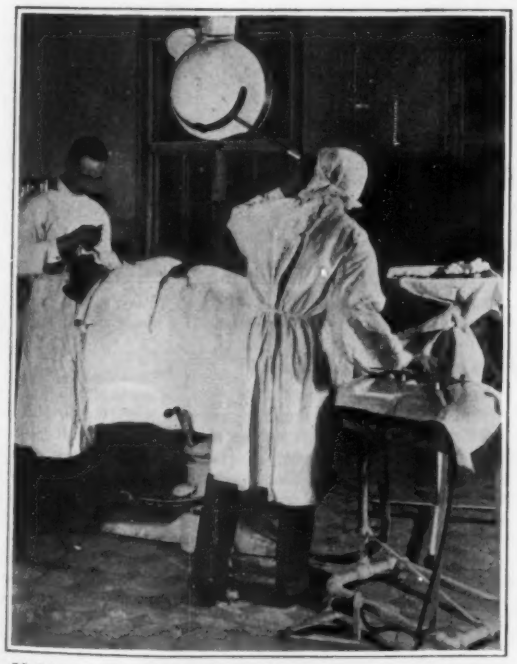
Of course, when such a film is projected at the ordinary rate of speed, objects move very slowly, one step of a runner, for instance, taking ten seconds or more on the screen. This makes the instrument of incalculable value in scientific and industrial work.

Keeping Track of Surgical Operations

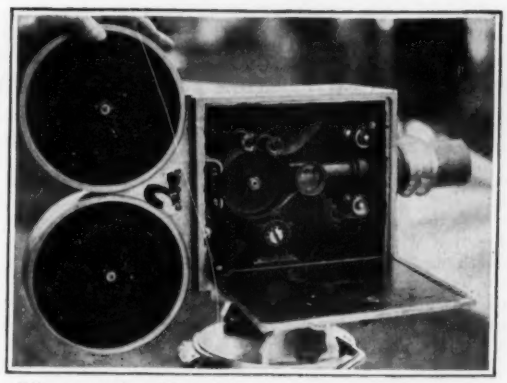
SURGERY, after all, is largely a matter of precedent. If one surgeon has met with success in handling a new kind of operation in a somewhat different manner than heretofore, his work immediately serves as a guide for other surgeons confronted with similar cases. So it becomes necessary to keep accurate records of various important operations without in any way interfering with the work of the surgeon and his assistants.

From Germany comes the interesting photograph shown in the lower left-hand corner, showing a new type of motion-picture camera especially intended for recording operations. The camera is mounted at the lower end of a long arm suspended from the ceiling of the operating room, directly over the operating table. The camera is carefully focused by looking through a sterilized periscopic sight, which also serves as a handle in aiming the lens. The camera is motor-driven, the necessary controls being placed on a small table to one side of the operating table.

A somewhat similar idea, although not of the recording character, is a reflecting projector device, which is also mounted over the operating table. The image of the operating table is projected on to a screen in another room, where it can be studied by students and others without disturbing the surgeon and his assistants.



Making a film of an operation by means of the new German motion-picture camera



Ultra-speed motion picture camera with case open to show straight pull action of film

Hot High-Nitrogen Gas in a Metal Mine

WHILE investigating the presence of heavy strata gases in certain mines of the East Tintic district of Utah, a small, local body of light, very hot gas of high nitrogen composition was noted in one of the mines. Observation and analyses indicate that this light gas was resulting from very rapid oxidation of finely disseminated pyrite, in lead-silver sulfide ore. The gas was actually mine air which had lost a large proportion of its oxygen content by reaction with the pyrite. This body of gas was hanging in a local high spot about 5 by 5 by 5 feet in size, caused by caving, at the end of a crosscut. Fifty feet from this spot, an air current of 6000 cubic feet per minute was entering the 5 by 7 foot crosscut from a raise from below.

On account of the vapor contained in the gas, the bottom level of the gas could be plainly seen and was practically a horizontal plane, but of slightly wavy appearance, coinciding with the point where an acetylene light was extinguished. This body of gas was visited on three occasions and samples obtained by means of evacuated bulbs and by water displacement. The temperature of the gas was approximately 175 degrees Fahrenheit on all three occasions, so that sampling required thick gloves and quick action. Air three feet below the vapor line had a temperature of only 120 degrees Fahrenheit, and a relative humidity of 27 per cent. The stratification of the air and gas mixtures was so sharply defined that the sampler could hold his head a few inches below the vapor level for an appreciable period of time without any noticeable effect other than that due to high temperature. At one foot below vapor level, it was 135 degrees Fahrenheit, and the relative humidity was 30 per cent. When a candle and an acetylene light were raised into the gas from below, the candle flame was extinguished at a point two inches lower than the acetylene flame, indicating a drop in oxygen content from about 16 per cent to 12 per cent (oxygen content of normal dry air 20.93 per cent) in the distance of two inches.

The analyses and the air-free calculations made therefrom show that the gas is black damp (defined by Haldane, the English physiologist, as an accumulation of carbon dioxide and nitrogen in proportions larger than those found in atmospheric air) composed almost wholly of nitrogen. The average analysis of normal dry atmospheric air is usually given as carbon dioxide (CO_2), 0.03 per cent, oxygen (O_2), 20.93 per cent, and nitrogen (N_2), 79.04 per cent. Included in the nitrogen percentage are the so-called rare gases of the atmosphere which constitute about one per cent of the total constituents of air, and, like nitrogen, are inert. Mine air always differs slightly in composition from the above, but in mines as well ventilated as this particular mine, the CO_2 percentage rarely goes above 0.2 or the oxygen percentage below 20.5, even at points as much as a mile distant from intake openings.

The analysis showed that as the elevation increased from 12 inches above the vapor level to four feet above this level (and one inch beneath the roof), temperature remained fixed at 175 degrees Fahrenheit and humidity at 100 per cent; carbon dioxide content increased from 0.17 to 0.38 per cent, oxygen decreased from 8.93 to 2.49 per cent, and nitrogen increased from 90.9 to 97.13 per cent. The calculated air-free composition of the black-damp was 0.48 per cent or less of carbon dioxide and the balance nitrogen. One inch below the visible vapor line, analysis of the atmosphere showed 0.17 per cent carbon dioxide, 20.27 per cent oxygen, and 79.56 per cent nitrogen—practically normal air. In every case, after the gas under analysis had been examined for carbon monoxide, hydrogen, and methane (CH_4), and none of them had been found, the nitrogen content was found by subtraction on the assumption that the balance of the gas was entirely nitrogen.

That the process of oxidation was still in rapid progress was evidenced by the fact that, although the body of gas occupied not more than 150 cubic feet and the vapor level was practically constant, a thin stream of hot gas, estimated at 25 cubic feet per minute, was flowing along the roof of the crosscut to the air current 50 feet away.

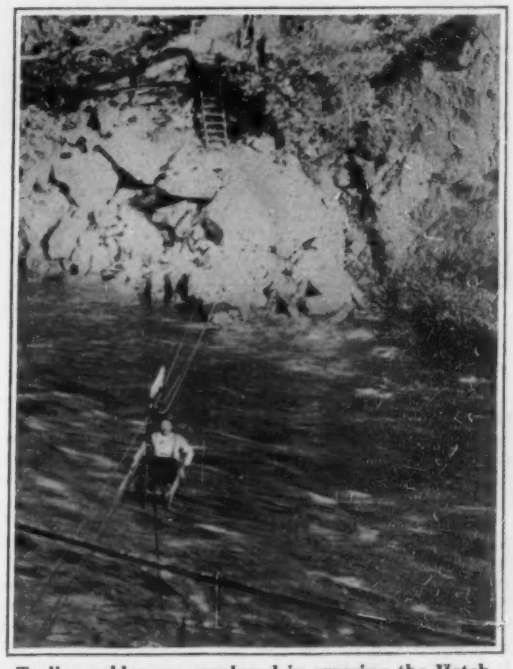
The tendency of such a mixture of air and gas to "hang" to the roof is due to its lighter weight as compared with the mine air. The difference in weight is due primarily to the differences in temperature and humidity, rather than to the difference in chemical composition, since nitrogen is very little lighter than air.

The gas had a strong, musty sulfur odor and had a suffocating effect when breathed. Attempts to prove the presence of sulfuric acid vapor in the body of gas were not determinate, although a very slight amount was undoubtedly present. The presence of this body of gas in this particular mine probably represents the first step in the production of certain heavy strata gases high in carbon dioxide content that affect mines in this district, that is, the production of residual atmospheres by oxidation of sulfides, accompanied by the production of heat, sulfur dioxide and sulfuric acid, the succeeding step being the production of carbon dioxide by reaction of the acid with carbonates present in the rock.

Deposition of dehydrated iron sulfate had formed a border about one foot wide and one-half inch thick on the surrounding walls, the upper edge corresponding with the vapor level, while the walls in contact with the gas had a leached and porous appearance. A sample of the material (pyritic lead-silver sulfide) from the wall in contact with the gas analyzed 7.8 per cent sulfur and 80.20 per cent insolubles while only 50 feet away and in the same ore body the sulfur content is reported to have run 14 to 25 per cent. Microscopic examination of thin sections of the same sample showed that the pyrite occurred both in masses and in finely disseminated grains, the individual grains of the masses averaging 0.1 millimeter (0.0039 inch) in diameter, while the disseminated grains were uniformly small, many of them measuring less than 0.004 millimeter (0.00016 inch) in diameter.

A Trolley Cable in Place of a Bridge

THE accompanying view in the lower right-hand corner shows an aerial tramway employed in carrying men and material across the Tuolumne River at Hetch Hetchy, in California. A heavy cable is stretched across the river, which supports the car, the latter being suspended below the cable on pulleys. These tramways make it unnecessary to travel great distances to the few bridges that cross the river.



Trolley cables are employed in crossing the Hetch Hetchy River in the absence of bridges

The Noiseless Elevated

Philadelphia's Plans for Making Conversation Possible While the Trains Are Passing

By William A. McGarry

AN elevated railroad over which trains of ten all-steel cars will roll at high speed with less disturbance of the surrounding atmosphere—and the eardrums of spectators—than that caused now by a single trolley car is nearing completion in Philadelphia. So far not a wheel of a passenger car has turned over its tracks. But engineers of the Philadelphia Department of City Transit say this road will be the quietest elevated railway in the world.

Instead of the usual ear-splitting rattle given off when a train passes, the noise of operation on this structure will be a deep rumble, something akin to the roar of artillery at a considerable distance. According to the engineers, it will be a noise of low pitch and of few vibrations compared to the familiar elevated train rattle; a noise that will cause far less interference with ordinary street conversation and that will be less of a nervous strain on the average citizen.

This achievement, if it may be so called in advance of its completion, will be the result of perhaps a score of little changes in methods of construction, and two or three major mechanical developments, many of which have been put into practice singly elsewhere. Some of these apply to the elevated structure and some to the cars being built for the line, but all may be summed up by the statement that the object sought was rigidity at all times; solidly built bridge work with vibrations minimized, and rigid trains with no free play at the couplings for the usual jolting during starting and stopping.

The line has been built by the city. It runs from a junction with the present Market street elevated in a north and northeasterly direction, roughly paralleling the course of the Delaware River for a distance of eleven miles, and is virtually completed now with the exception of interior work on some of the stations, and the equipment. Its operation has been delayed by failure of the city and the Philadelphia Rapid Transit Company to reach an agreement on a lease; with the result that the city is now building its own sub-stations, three in number, to distribute the current for operation, and is having built fifty steel cars containing many new features.

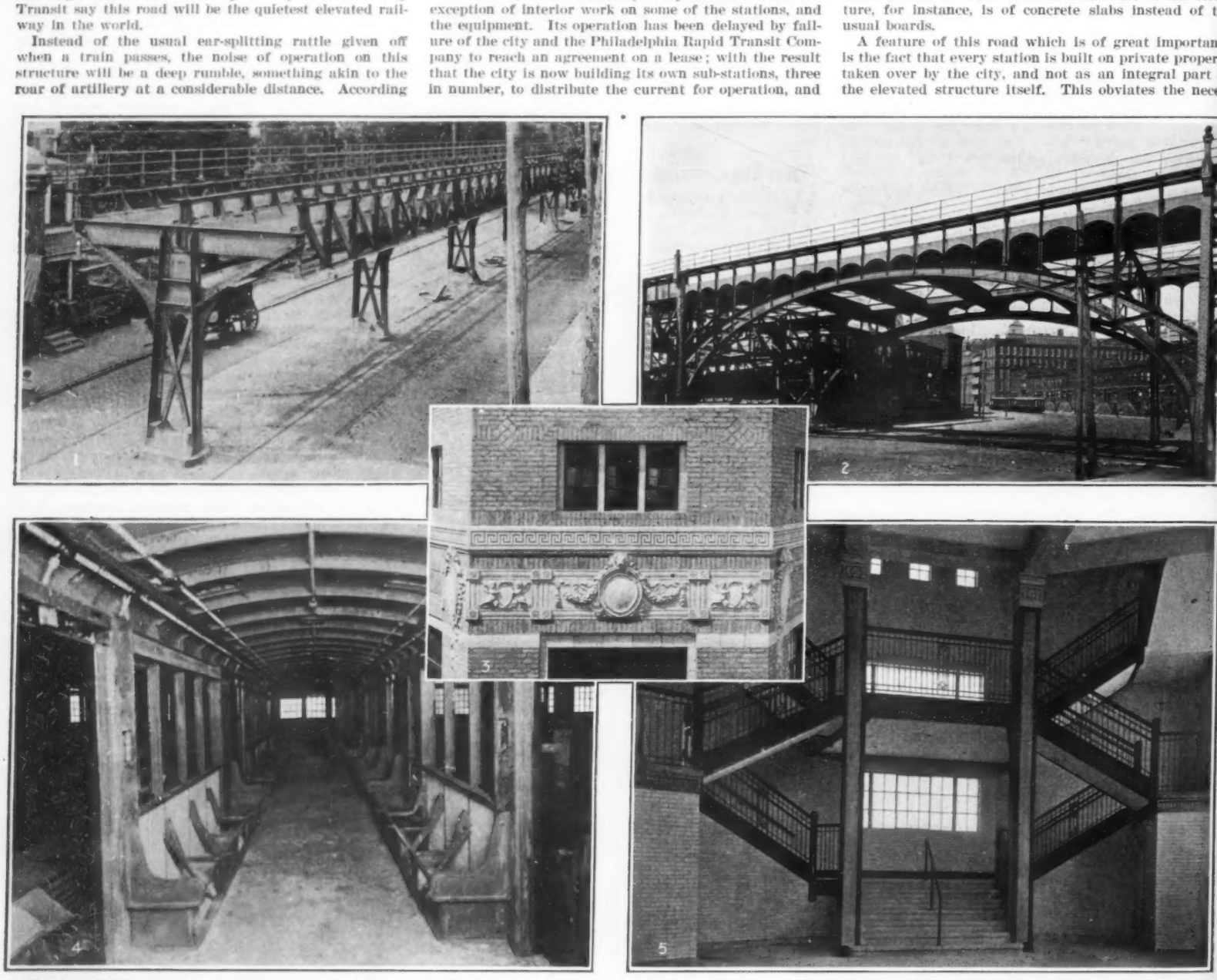
The structural features of the road are a development of those used in the old Market street elevated, completed in 1905, which is exceedingly quiet in operation compared to some of the New York and Boston elevated lines. That structure rests on H-beam uprights, with a flat steel and concrete deck, and a rock-ballasted roadway. In the new line the channels of the H-beams are filled solidly with concrete, and the deck is made up of small concrete arches, as shown in the illustrations. These have been tested to a weight of thirty tons per square foot without showing any signs of failure.

Virtually the only noise-deadening feature of the Market street line is the rock ballast, but this, as has been said, makes a great improvement over the roads on which ties are laid directly on the steel. The concrete filling in the beam channels and the arch flooring are expected to cut the noise in half in the operation of the Frankford elevated, as the new line is known. The same effort for rigidity has been made throughout the construction. The footwalk on both sides of the structure, for instance, is of concrete slabs instead of the usual boards.

A feature of this road which is of great importance is the fact that every station is built on private property taken over by the city, and not as an integral part of the elevated structure itself. This obviates the necessity of taking up sidewalk room with stairways. The building lines of these stations have been set well back in order to provide plenty of room for any future congestion. Passengers enter a building resembling a bank, go up by easy stages and cross a bridge at platform level to reach the cars.

Short ties—a separate set for each rail—are used in the roadbed at the stations in order to facilitate the clearing away of the rubbish and litter thrown on the tracks by passengers waiting for trains. These ties are fastened directly to the concrete slabs, as the speed of trains at all stations will be so slight as to make the noise-deadening ballast unnecessary.

One stretch of the elevated, about two miles in length, is rather novel. It is said to be the only cruciform type



1. The elevated structure south of Dyre St., showing single-column or T-bent type of structure on Frankford Ave., carrying two tracks. 2. The clear arch span of 112 feet over Lehigh Ave., showing the jack arch concrete floor. 3. A detail of the ornamental work at the Allegheny Ave. station. 4. Interior view of partly finished car, showing longitudinal seat arrangement designed for maximum carrying capacity. 5. Interior view of one of the stations, showing stairs from main floor to platform floor

Structure, cars and stations that contribute to the comparative noiselessness of Philadelphia's new elevated railroad

elevated in this country carrying two tracks, although there are several short stretches of single-pillar elevated lines supporting single tracks. This type of construction was used in a section of the city where the line traverses narrow streets, in order to avoid darkening the thoroughfare and the stores and dwellings. By way of anchorage the footings of columns, which rise from the center line of the street between double surface tracks, are spread out under these tracks, thus assuring extreme rigidity.

A test car was loaded with seventy tons of steel rails and placed at different points along the line of the cruciform structure for the purpose of testing the strength of various members. No failure or excess stress was shown under the greatest concentration of load that will be possible in operation. The most severe strains here, of course, occur with the load on only one track. Throughout the line a protecting rail of steel is used instead of the wooden rail used on some lines. This is a regular track rail and not the familiar lighter type. Engineers say that it will be impossible for a car to go off the structure after derailment, with this guard rail in place.

Unusual care has been given all along the line of the elevated to the question of preventing the darkening of streets. The entire under-surface, except over steam railroad lines, is painted gray, above the six foot line. Columns are painted dark green to that height because splashing from vehicles would soon ruin the gray. The effect of this is a considerable increase of light even on narrow streets. Surface drainage is so controlled that there will be little dripping from the sides of the elevated, the water being conducted direct to sewers.

The cars follow the lines of the new Brooklyn cars in some respects, but offer many improvements. They are limited by turns in the road to a length of 55 feet, and by conditions in the Market street subway—with which the new line will connect—to a width of eight feet ten inches. Seating capacity is 51 passengers, with total room for about 200. The silencing feature of the cars is the adoption of a new type of gear with which experiments have been made on the Long Island road for some time, with satisfactory results. It is something like a worm gear. This is installed between the motor and the car wheels. In ordinary trolley car construction a straight-edge gear is used, and after a car of this type has been in use for some time it becomes noisy, due to gear rattling. Engineers of the transit department have made an exhaustive study of car noises and have determined that a great percentage of this noise comes from the gears in the operating machinery. The new type of gear is set at an angle so that the grip at all times is by three teeth on each gear, instead of one, and regardless of the age or length of service of the car, rattling is impossible so long as the gears are sufficiently sound to make operation possible at all.

Elimination of noise is obtained also by the use of a patented coupling device which couples cars, current and air by simply running the cars together. Each coupler is equipped with a cover plate which snaps shut over the electrical connections when the cars are separated. The couplers are so tight that a hose may be turned on them without getting any moisture to the electrical connections. Installations of these devices are a development made as a result of the study of patented automatic couplers in use experimentally elsewhere, particularly in New York.

The only air coupling possible in an automatic device of this kind was a butt connection. In ordinary construction there is a great deal of lateral and perpendicular play in the draft gear, and this adds in no small part to the general racket. It was necessary in the automatic coupler to have the butt connection absolutely tight, which means constantly rigid. And by attaining this the engineers attained also a train rigidity that is expected to prevent the usual jarring and jerking at starting. In other words, a train of eight or ten cars will start and stop as a single unit. The safety feature is the most important in automatic coupling, but the saving of time and labor is a considerable item.

Safety features of these cars are the most advanced so far designed. A red light burns beside the motorman when all the doors are closed. Doors will be operated by separate air motors controlled electrically by multiple unit control, under a pressure of 360 pounds, which is expected to take care of winter conditions and dirt in the door track. Without a safety device this pressure, of course, would be dangerous. Accordingly the end of the door contains a spring, longitudinal, so arranged that a light touch on it makes an electrical contact that reverses the motion of the sliding door. This device is so sensitive and so sure that, according to the engineers, a passenger can stop the shutting of the door with his face without suffering the slightest injury. Patrons of the New York subway will recognize it as fundamentally the same as the device recently installed to enable the Interborough trains to run with one guard, for two cars, stationed on alternate platforms.

After the door flies open its motion is again automatically reversed and it starts to close. It will continue to run back and forth as long as there is an obstruction. The builders realize that passengers will soon become aware of this and will take advantage of it to hold the door open for friends. Accordingly a key is supplied to station men which will cause the door to close, suspending the operation of the safety spring, when inserted into a hole on the side of the car near the door. The New York subway cars might advantageously be equipped with something of the same sort, though the station man is usually able to solve the problem by a display of force.

It is estimated that in the ordinary platform car with end and center doors the average walk of the passenger inside the car is one-third the length of the vehicle. In the new cars for this line the average walk will be one-sixth the length of the car. Doors are placed not only equidistant on the car, but also as regards the station. There are no platforms and this permits the use of room that generally goes to waste. The conductor is provided with a set of buttons. One controls all doors, and there are separate buttons for separate doors if their use in that way becomes necessary. There is a step up by which the conductor may look over the heads of passengers. The placing of the doors is expected to bring about a great saving of time in loading and unloading cars, and also a better distribution of passengers with consequent elimination of congestion.

Air to the brakes is applied electrically for the whole length of the train, thus vastly decreasing the time necessary for a full stop. In event of a break in the current the same operation of the control applies the brakes in the usual method.

The test house of metal lumber in Canton, O.

Lumber of Steel

THAT metal lumber provides a most practicable home-building material is indicated by an exhibit recently completed in Canton, Ohio. A two-story metal house was constructed to show that metal lumber construction has reached a perfected stage.

From this house plans and drawings for homes of varying types, dimensions and costs will be evolved to meet the taste and purse of every home builder. For each standard house every metal joist, stud and channel will be supplied of an exact size, so that all parts fit quickly and easily. Spikes and nails are replaced by bolts (⅜ inch and 7/16 inch) in the assembly of metal lumber.

The general plan of construction in the house erected will be followed in all. The framing of the outer walls is of four-inch channel shapes, on the inner and outer flanges of which are prongs, punched for the attachment of metal lath. Partitions are erected of two or four inch studs, on both sides of which metal lath is affixed. Plaster is then applied as in homes of wood construction. The floors are constructed by using metal joists, spaced by two feet. Strips are nailed to these joists and wood or composition floors may be installed as in any conventional construction building.

Metal lath goes quickly into place on the bottoms of these joists to provide ceilings. Metal lumber rafters support the roof to which nailing strips are attached. Any form of roofing desired may be applied. Wood grounds are applied for the installation of windows, door frames, baseboards, picture molding, etc. In the finished house no metal can be seen, inside or out.

An exterior finish of stucco is used. It is pointed out that in a building of such firm framework this stucco will be permanently free from cracks, sometimes caused by settling or "weaving." Plaster and interior finishes will also be preserved.

The steel structure is imbedded in the foundations at all points and is thus anchored securely. The foundations may be of any standard type. Fire risk is reduced to a minimum. The building is far more fire-resistive than a brick house with wood partitions. Fire can not get in from the outside and is confined to any room in which the blaze originates.

Diminished Flax Acreage in Ireland

FOLLOWING a recent official survey of the acreage in Ireland under flax during the present season, it is announced that the growing area is 40,000 acres, as compared with 127,000 acres last year, reports the American consulate at Belfast. The reason for the decreased acreage this year is to be found in the reaction of farmers from the artificial stimulus afforded by a Government bounty, now withdrawn, and by the contribution by the linen manufacturers themselves of the sum of £630,000 to the flax growers as an additional bonus during 1919 to promote the growth of flax at a time when linen products were commanding phenomenal prices. Coincident withdrawal of both these inducements for a supernormal crop has resulted in a subnormal one—Irish farmers apparently possessing their fair share of human nature.

Manufacturers are unable to forecast the result of this flax shortage upon the linen market in the near future. There is much flax, they assert, in the hands of farmers, unsold, which is being retained in the hope of higher prices. They claim that, in view of the world-wide depression in business, they are unable to sell linens at remunerative prices or to create a demand for flax at such a price as will induce the farmer to sow the normal acreage. Everything depends upon a return of business to its usual volume. Should this condition arise suddenly, the flax shortage would become acute, as it is claimed that the quantity held in reserve by the farmers would not supply the Belfast mills for a period longer than three months were they all to resume work at full capacity.

A Novel Sprinkler for Golf Greens

EVER since the artificial watering of golf greens has been resorted to as a dependable method of maintaining the turf and grass in a vigorous, growing condition during periods of droughty weather, difficulties have been experienced in shifting the sprinklers and hose about so as not to injure the green with foot tracks or other objectionable marks. At the Wawonowin Golf Club, Ishpeming, Michigan, this problem has been solved successfully by the perfection of a home-made sprinkler made of corrugated carbide cans which are so arranged that they can be shifted about the green even when it is soaked with water without damaging the grass in any way. Any large, round can could be used instead of carbide cans, the outstanding feature of importance about these containers is that they are made with corrugated surfaces which cannot be dented easily.

Large carbide cans form the basis of this interesting system of lawn sprinklers, which is said not to injure the grass in any way

Wooden ends are placed in the carbide cans and each of these covers is perforated in the center so that they will carry a ¾-inch pipe. The cans are spaced at intervals in such a manner that they really operate as rollers for the pipe, which in turn is connected to the water hydrants and hose. A simple sprinkler which will not get out of order or clog is placed at each end of a length of pipe. The distance between the sprinklers is determined by the water pressure in the locality where the novel sprinkler is used. At the country club where this plan was originated the sprinklers are placed 26 feet apart so that they water a green zone 52 feet wide. By the use of hose 75 feet long, greens which are not over 150 feet wide can be sprinkled satisfactorily from faucets on each side. The sprinkling is started at one end of the green and as the various zones in turn are watered thoroughly, the sprinkling apparatus can be pulled gently toward the other end of the green without any damage to the turf and without the necessity of the attendants stepping over the saturated greensward. The extra carbide can nearest where the hose is attached to the pipe has to be removed after a revolution or two, but by that time the can has reached dry ground. The other cans serving as idlers support the line of hose.

Any competent workman can construct one of these novel green sprinkling outfits in about three hours. This home-made device is superior to all the commercial revolving types of sprinklers, which begin to wear out immediately after they make their first revolution and soon produce uneven distribution of the water. The Michigan sprinkler is cheap, durable and efficient; it is light in weight and can be readily carried in one hand. The sprinklers are so cheap that the best plan is to provide enough for each green on the golf course. They are particularly valuable for watering greens at night during hot, dry, summer weather, when it is almost impossible for workmen to operate the ordinary run of green sprinklers in the dark without damaging the greens in one way or another.—By *G. H. Dacy.*

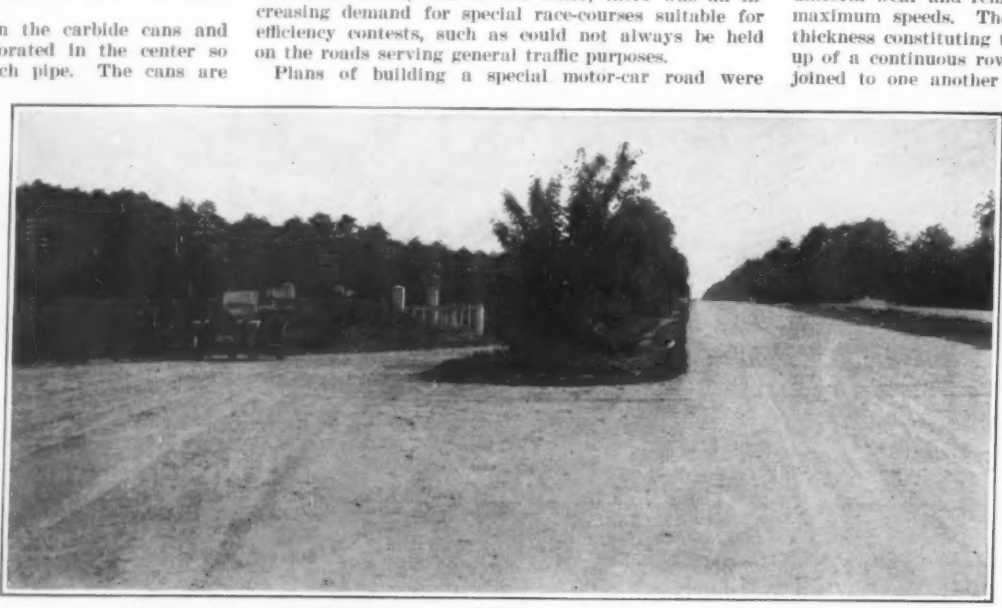
The Grunewald Automobile Race-Course

THE necessity of a special automobile road in the neighborhood of Berlin had long before the war made itself felt in an ever-increasing degree: On the one hand, the pedestrian and vehicular traffic was more and more inconvenienced by the rapidly growing motor-car traffic, and on the other, there was an increasing demand for special race-courses suitable for efficiency contests, such as could not always be held on the roads serving general traffic purposes.

Plans of building a special motor-car road were therefore suggested as far back as in 1906, in connection with the Taunus races, but not until the last years preceding the world war could these be brought to a happy end. A special company was founded with the cooperation of the municipal corporations of Greater Berlin, which for a period of 30 years rented a strip of land 6 miles long and about 45 yards in average width, extending from Witzleben Station, at the entrance to the Grunewald forest, to Wannsee Lake.

The aim of the undertaking was to provide a motor-car road embodying the best practice of road building both in European countries and the United States and taking into account the experience gained in connection with international automobile contests. While no comparative data on the roads built in this country are available at the time of writing, the constructors claim for the new race-course the distinction of being the most remarkable in Europe.

From a constructive point of view, the road presents a number of interesting features. It is made up of two parallel straight courses, connected together at the north and south ends, respectively, by huge curves, its total length being 12 miles. Whereas in the case of motor-car roads previously built, the top line of the curved surface runs in the middle, the new road is so designed that cars entering it on the right will keep their wheels at constant height, thus affording the double advantage of uniform wear and remarkable ease of control, even at maximum speeds. The stone layer about 25 cms. in thickness constituting the bedding of the road is made up of a continuous row of coping stones 25 cms. high, joined to one another and which, being let down to the level of the road, constitute on both sides an invisible concrete wall. The road traverses practically level ground and, accordingly, can readily be inspected over a considerable length, which, of course, greatly increases the safety of traffic.

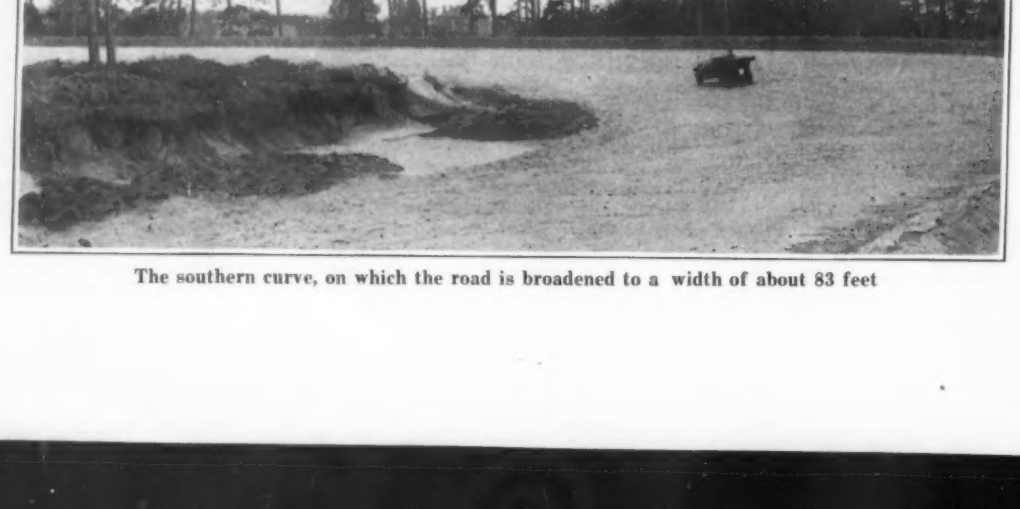


Berlin's new automobile parkway, with one of the feeder roads leading into it (from the left in this view)

Concrete viaducts (20 altogether) have been provided at each crossroad, thus avoiding any level crossing. The two rectilinear courses run close to one another; inasmuch as each of them is traversed in one direction only, any risk of collision of cars traveling in opposite directions is avoided. The width of the road (26½ feet) is so calculated as to allow four cars at the same time to overtake one another. Parallel to the road there are grass strips running outward and inward, to which any damaged cars can be removed in safety. The special configuration of the road section causes the driver automatically to keep to the right. The design of the tarred upper layer insures imperviousness to water and perfect freedom from dust.

The construction of the road was, in 1914, nearing completion, so that its inauguration could be anticipated for the fall of that year. However, the world war and its immediate after-effects, from 1914 to 1920, temporarily stopped the work. This long period of enforced idleness has, by the way, done the road no material harm. On the contrary, the race-course has had time to settle and will not undergo any further deformation. Moreover, a few months have been sufficient to rid the road of its weeds, and to renew the gravel layer. The tarring is but a matter of a few days, so that the road was ready for training for the automobile races in September.

At the very last moment the company decided on enlarging the Southern curve to a width of about 83 feet and a superelevation of 1.7; and a similar enlargment of the northern curve is being contemplated for the near future. The two curves are 376 feet and 940 feet, respectively, in diameter.—By *Dr. Alfred Gradenwitz.*



The southern curve, on which the road is broadened to a width of about 83 feet

Bombing and Bombing Sights

How Aiming from the Unstable Platform of an Airplane Is Made Possible

By Dr. E. J. Loring, Army Ordnance Engineer

NAVIGATION of the air was scarcely a proven possibility before consideration was given to its military uses. Even the earliest airplane meets had their "bombing" contests of dropping bags of flour or oranges upon targets outlined on the ground. Small wonder, then, that with the advent of the war the inventive resources of the nations were turned to the new locomotion and to the development of its possibilities. The first uses were naturally for reconnaissance and fire control, but the capabilities for offensive use were clearly evident, and there followed the dropping of steel darts on assemblages of troops and animals, of incendiary grenades on grain fields, and before long the Zeppelin bombing raids. The development of bombs and airplanes progressed together—larger bombs and airplanes of greater lifting capacity and greater cruising radius to carry them—until at the close of the war each principal nation had built or projected a bomb of 1000 pounds weight or more of which about half the entire weight was high explosive. Other types of bombs were also developed: fragmentation bombs to scatter the sharp fragments of the bursting case among personnel; incendiary bombs to start fires from a shower of burning material or from a mass of oil with a high temperature core; bombs with smoke-producing liquids; bombs to give high-power illumination; to pierce armor plate; and for submarine attack.

Of all these types, the greatest development was in the demolition bomb with its great mass of high explosive, reaching the greatest weight contained in any projectile, and the enormous power of such bombs when favorably placed has been shown lately in the sinking of the German ships and the ex-U.S.S. "Alabama."

It is not generally contended that these results are truly indicative of the results to be expected in actual warfare today; the tests were rather to show the results of which the bombs are capable when favorably placed, and the question of placing them is another matter. For it is only the hits—direct, or alongside of ships—that actually count; all others are without effect except on morale, and unless some desired point is within the destructive area of the bomb as it hits, the bomb and all the time, energy and expense of its production and transportation and the risks to airplane and personnel have been ineffective and wasted.

The efficient functioning of the bomb and its fuses is thus a distinct problem from that of efficiently placing the bomb, and with the increasing power of the anti-aircraft defense, driving the airplane to higher altitudes, the problem of placing the bomb becomes increasingly difficult.

At the close of the world war the usual altitudes were 15,000 to 17,000 feet for day bombing, 8000 for night, 4000 for naval and 2000 to 1000 feet for submarines. While at the lower altitudes judgment and experience might be sufficient, at the higher altitudes definite guides for aiming became a necessity.

From the day-bombing altitude of 15,000 feet the head of a common pin held at arm's length covers a circle of about 50 feet diameter on the ground, a circle that will enclose the ordinary farmhouse, and is about the size of the crater of a 600-pound bomb, and the airplane traverses this diameter in from one-fifth to three-fifths of a second. With a delay fuse, the size of the crater is a fair measure of the destructive effect of a demolition bomb, and with a fuse giving one-half second delay or more, the diameter in soft soil is about

$$4\sqrt[3]{\text{weight of bomb}} \quad \text{or} \quad 5\sqrt[3]{\text{weight of explosive}}$$

The actual destructive area is somewhat greater; for the 2000-pound bomb the crater is about 50 feet across, but dropped in woods with instantaneous fuse the destruction covers 200 feet radius. Figure 1 shows the apparent size of the destructive areas for several sizes of bombs at the usual altitudes, if viewed from the height of a table, and represents the relative area within which the bomb must be dropped to have effect. Another view shows the effect of a direct hit on a railroad track with a 112-pound bomb, and it will be seen that a hit twenty feet to either side would have done far less damage.

In order to place the bomb within this limited area the flight of the airplane must be directed in a certain definite relation to it, and the bomb released at the precise instant on that flight, with a leeway of not over one-fifth of a second. At the instant of release the bomb has the motion of the airplane, that is, the actual motion in relation to the ground, and the control of the direction of this motion for a point one to three thousand feet ahead requires more than a simple observation. Further, the bomber usually has no direct control of the direction of the airplane, and can guide it only through the pilot, with whom he may communicate by signal or by reins on the pilot's elbows; and almost every airplane, whether bombing or otherwise, is "blind," so that the pilot, from his seat, is unable to see the ground at the bombing angle. The bomber, too, unless located in the prow, has only a very limited view of the target, and at low altitudes can see it only a very little time before the bomb must be released, during which time he must recognize the target, and possibly correct the direction of the airplane and set his sights.

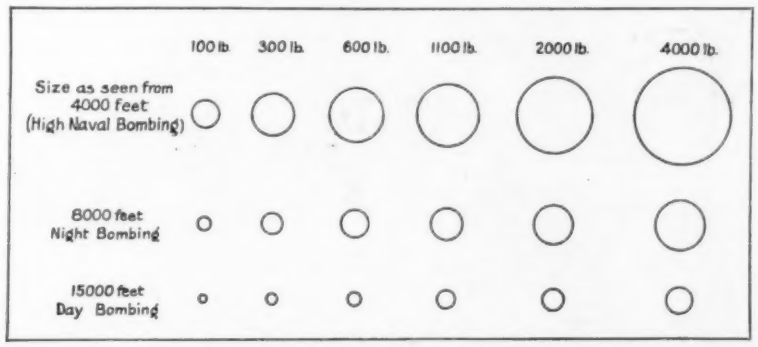


Fig. 1. This diagram viewed from the height of a table, represents the area of destruction for demolition bombs (50% explosive) of the respective weights, as seen from the altitudes given

The bomb when released from the airplane continues in motion with it, but is immediately subject to the action of gravity, acting vertically downward, and the bomb takes up a downward motion in addition to the forward motion which it already has. The effect to the bomber is as though he were fixed in space and shooting at the rapidly moving target with a low-power gun that is fixed vertically; he can not point his gun, but can only await the proper moment to fire it. He knows that it is fixed on the vertical, but he can neither see the gun nor see the vertical to recognize it, for the sense of vertical is nearly lost in an airplane, and is sensible only from the perspective of the earth's surface. No pendulum or spirit level can give it, but will only indicate the apparent vertical which departs from the true vertical on every bump, pitch, side-slip or turn of the airplane. Whether on foot, bicycle, automobile, ship or airplane, no course is ever laid truly on a straight line, but at best is a succession of slightly curving paths on which an error of direction is accumulated until recognized, and then corrected. These curves may be slight, but lateral forces arise instantly and cause deviations of any pendulum or similar device.

A deviation of one degree is an error of 175 feet on the ground at 10,000 feet, and is a complete miss.

DEVIATION OF A PENDULUM FROM THE VERTICAL ON A TURN

Deviation degrees	Speed of airplane 100 ft/sec		Speed of airplane 150 ft/sec	
	Radius feet	Time for complete turn	Radius feet	Time for complete turn
1	17820	18 min. 40 sec.	40100	28 min. 0 sec.
2	8910	9 " 20 "	20400	14 " 15 "
3	5940	6 " 13 "	13600	8 " 30 "
5	3556	3 " 43 "	8000	5 " 35 "
7	2532	2 " 39 "	5700	4 " 0 "
10	1765	1 " 51 "	3945	2 " 45 "
20	855	54 "	1924	1 " 21 "
30	539	34 "	1213	51 "

Note: Radius, feet $=0.311 \frac{V^2}{\tan O}$

Seconds on turn $=1.955 \frac{V}{\tan O}$

V = ft/sec O = angle

Thus the bomber, shooting from his unstable platform at the rapidly moving target, unable to direct his shot except in part by directing the airplane itself through the pilot, can not by his own senses or by any ordinary apparatus determine precisely the forward path of the bomb or the vertical from which to determine its range.

To show something of this difficulty of sighting on the vertical, even under the best conditions, place the sheet with Figure 1 on the floor, select any particular circle, and try to drop a pencil into it from the level of your eyes; or better, place it a few inches from the edge of a platform, 5 feet high, and try to roll a marble off the platform to hit within the selected circle while someone moves the figure.

With this great and fundamental difficulty of getting the vertical, many efforts have been made to find other means of finding or holding the vertical. So far there has been but one true vertical observed from an airplane, its own reflection in still water below it, as found by Major F. C. Brown, and on this phenomenon the Ordnance Department of the Army has based its trajectory tests, photographing the falling bomb against the reflection of the airplane with a moving picture camera. An observation method is by the use of two vertical mirrors at about 45 degrees to the line of sight to right and left; when the horizon shows at the same height in both mirrors the intersection of their planes is a vertical line. For service use, however, the development is toward the use of a gyroscope, to give a reference line or to actually hold the bomb sight in position. Such a gyroscope is very sensitive. It may carry the sighting apparatus directly upon it or may hold the apparatus parallel to itself by the action of relay mechanism, by which means the apparatus may be handled without disturbing the gyro. Figure 3 shows a stabilizer of the first type, with the attached sight. This gyro has a three-phase electric motor taking current from a special generator, driven by an air fan in the slip-stream of the propeller

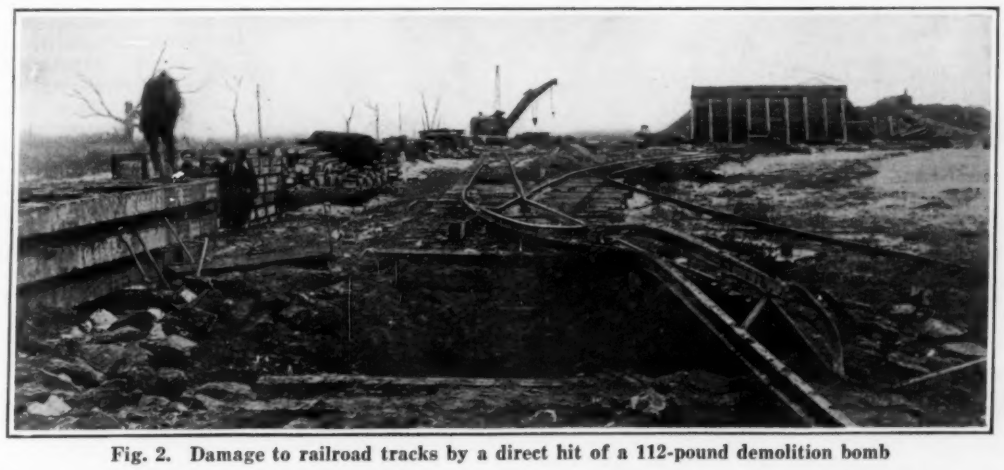


Fig. 2. Damage to railroad tracks by a direct hit of a 112-pound demolition bomb

The Bomb Trajectory. A body dropped in the car of a railroad train in motion falls to the floor at the same point it would strike if the car were at rest, and if dropped outside the car it would fall on a vertical line as seen from the car, except for the effects of the resistance of the air. In the same manner, the horizontal momentum given the bomb while on the airplane carries the bomb forward during its fall and determines the

direction of its path, and if there were no resistance from the air the bomb would always be vertically under the airplane, but because of this air resistance the bomb lags behind in its path, both vertically and horizontally, so that unless otherwise directed by the vanes in a manner which will be referred to later the bomb is always behind the vertical from the airplane, this distance at the ground being called the "trail."

From the airplane it is the ground that seems to move, and the bomber is endeavoring to shoot against a target moving with the speed of the airplane. The bomb at its release seems to fall down an inclined curved line at the rear to the ground. This is the one and only direction in which the bomber may shoot, and his only control in range is to release at such an instant that the bomb falling down this inclined curved line reaches the ground in precisely the same time that the target takes to reach this line, so that bomb and target meet. This is much the same as shooting ahead of a flying bird to bring it down, but in this case there is no choice of angle or point at which the hit is to be made, as is had by pointing the gun; the hit must be at the trail, and the bomb must be released ahead so that the target reaches that point at the same instant as the bomb.

These conditions are shown in Figure 4; a bomb released at O falls along the curved path OHA, striking the ground at A, the airplane in the meantime moving to B. The bomb, as seen from the airplane, falls down the curved path BA to the point of hit, seen at the angle LBA behind the vertical BL. If there were no air resistance, the bomb would at all times be vertically under the airplane as at F and G and would fall along the dotted curved path OGDC, a parabola, reaching the ground at D. The angle from the point of release to the point of hit, from which the latter would be predicted, is given then by the relation:

$$\text{tangent of angle of sight} = \frac{\text{travel of plane during fall, less trail}}{\text{altitude of plane}} = \frac{OB - AL}{BL}$$

Knowing the vertical, the speed of the plane in relation to the ground, the altitude, and the characteristics of the bomb, lines or points may be set up in an apparatus in the airplane to form triangles with sides parallel to the lines of the figure, and thus predict or indicate at each instant that point on the ground that would be hit by a bomb released at that instant. The sides of such triangles may be proportioned to distances or to velocities; for example, *am* may represent the mean velocity of fall and *ob* the ground speed of the airplane, or *am* may represent the altitude and *ob* the travel of the plane for the time the bomb is in the air, and it is on such a basis that all bomb sights are constructed, although with many modifications.

Most bomb sights at present in use have been intended for use only in the plane of the wind—that is, up or down wind, but this restriction is a very serious one, particularly where there is an effective anti-aircraft defence, as the directions of attack are then known in advance, and several bomb sights have been devised to permit of use in any direction to the wind. The action in a cross wind is readily understood if we consider that the effect of the wind, as seen from the airplane, is to blow the ground away up wind. In Figure 6, a view in plan, the airplane is at O flying with its axis directed along OA when the bomb is released, and during the fall of the bomb the wind has moved the distance and direction AA′, carrying with it the entire plane in the air containing the airplane and bomb to the position O′A′ at the instant of hit. The point of hit is still in the plane of the axis of the airplane, as with no wind, since the bomb has received only the same lateral displacement as the airplane itself, but this point is no longer on the projecting path of the airplane OL but to one side. This correction may be made in the construction of the bombsight by setting the trail correction always in the axis of the airplane while deviating the line or plane of sight to the side.

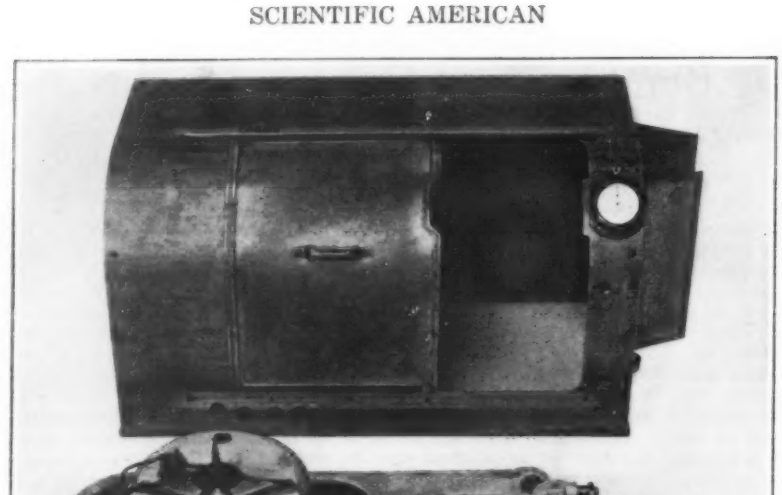


Fig. 3. Gyro stabilizer and attached bomb sight. Cross sections hold the bomb sight parallel to the gyro axis, and devices of the gyro control balance weights that tend to hold the gyro axis vertical. A. Timing and trail knob. B. Altitude knob. C. Collimator, directed on line of sight. D. Glass window in base

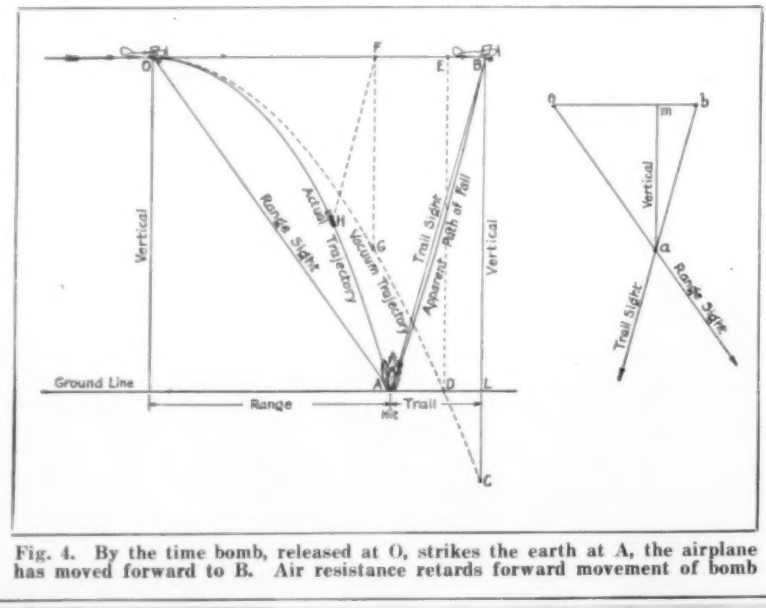


Fig. 4. By the time bomb, released at O, strikes the earth at A, the airplane has moved forward to B. Air resistance retards forward movement of bomb

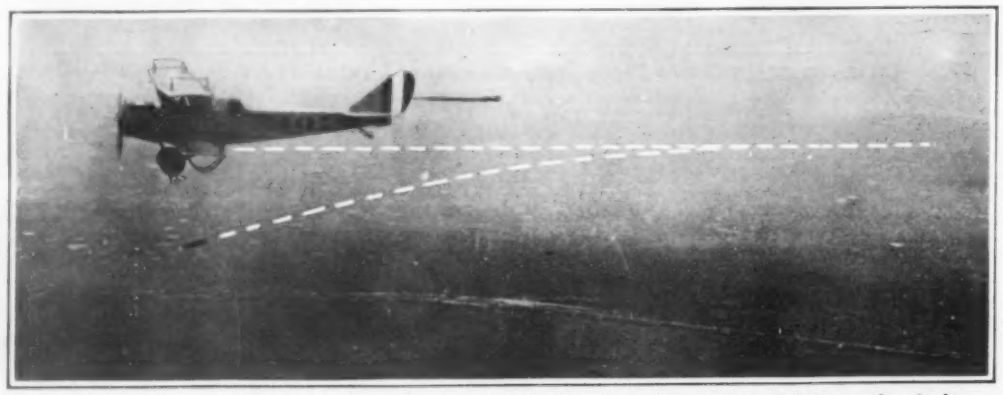


Fig. 5. Bomb dropped from airplane, showing true flight. Note how the bomb follows the airplane

In every bombsight it is necessary to establish a line of sight—the range sight—from which the target will move to the trail position in the time of fall of the bomb. To establish this it is necessary to have some measure of the ground speed, and this has been done by timing, either directly over a measured distance, or indirectly by coincidence methods; by synchronizing, in which a part of the apparatus is caused to move at the same apparent speed as that of the ground; from data of air speed and wind speed and observation of drift; and by compounding the apparent motion of the ground with a known lateral motion. Figure 7 is known as the "equidistant" method; there are three points an equal distance apart, the rear point being on the trail sight; there is a reversing stop watch, having an indicator which may be at the time of fall of the bomb, indicated by an altitude scale. The watch is started in the normal direction when the target passes the first line of sight, reversed when it passes the second, and the bomb is released when the hand returns to the position of the indicator; the hand, continuing, will reach the starting point when the bomb reaches the ground and the target reaches the line of the trail sight. The principles of Figure 8 have been used a great deal. There are two scales, one for altitude and one for time, corresponding for the particular bomb in use. The time is taken for any object to pass from the altitude point to the trail, and a point is set at this time on the time scale, giving the range sight, indicating the point on the ground that the bomb will hit, so long as the airplane continues to fly at that speed and direction.

The values for the trail for a given bomb are obtained with great difficulty through long and tedious tests and computations. They depend chiefly on the factors of altitude, air speed, and the shape, weight and resistance of the bomb at various speeds, and the variation of air density. Most sights are arranged for only one set of conditions, but it has been found possible to arrange apparatus to take account of all factors for different bombs with only a slight maximum error.

The bomb sight indicates to the bomber the point on the ground which would be hit by a bomb released at that instant, taking consideration of the ground speed, wind speed and direction, air speed, altitude, and the bomb's characteristics; or with considerable of these factors, it may indicate the proper moment of release, or perform that function automatically. The complete sighting apparatus is required also to determine the speed and direction of the airplane and of the wind in relation to the ground, and to show the proper direction of the axis of the airplane to reach a given target and to communicate this direction to the pilot.

The bomb is an elongated body provided with fins or vanes at the rear to direct it on its path. But the path is curving, as shown in Figure

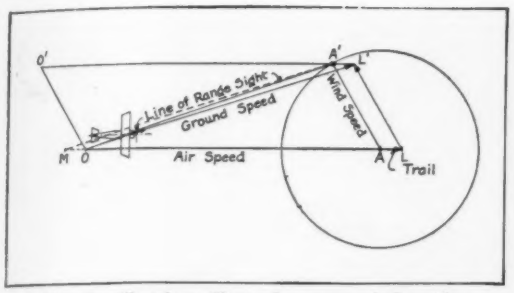


Fig. 6. Showing effect of a cross wind on the path of an airplane

4, and if the bomb is not properly proportioned or the vanes have been damaged, the bomb may not turn sufficiently and may move at an angle with its path. If this angle becomes great, the forces on the vanes may change the path; if nosing up, or hanging back on the turn, as at A, Figure 10, the bomb is forced forward or "skids" at the expense of its downward velocity; if nosing down, as at B, it may be forced down in a more nearly vertical path at increased speed, transforming its forward into downward motion, so that it may reach the ground in even less time than the theoretical bomb of no air resistance. Figure 5 shows a bomb properly directed on its path. Figure 11 shows three bombs, one flying true and two nosing up. Figure 9 shows the path of two bombs, supposed to be similar in every way, one of which fell true and the other wobbled or possibly even cartwheeled. It is impossible to predict these variations, but fortunately they are much reduced with increase of size. Accurate bombing not only requires that a bomb take a certain path, but that it always take the same path, so that its point of hit may be predicted.

It will be seen that it is by no means a simple matter to direct an airplane and release a bomb under trying conditions in a manner to obtain a hit. It requires good training and team work in pilot and bomber, steady nerves, quick reaction, a special class of personnel, sighting apparatus of a special nature, steady airplanes, and a careful proportioning of the bombs for steady flight. But good bombing will place a given weight of bombs against a target with less loss of bombs, of airplanes and of personnel.

Probable Limits of Electric Generators and Superpower Plants for Germany

WRITING in *Zeitschrift des Vereines deutscher Ingenieure* for August 27, 1921, and abstracted in *Mechanical Engineering* for November, Prof. W. Reichel discusses the problem of the most economical and the largest commercially possible sizes of electric generators for central stations. The economy of large units is generally recognized and an interesting discussion is devoted to the question as to the largest possible sizes.

The most advisable speeds for various sizes are given as 3000 r.p.m. for generators up to 25,000 kva., 1500 r.p.m. for generators up to 40,000 kva., and 1000 r.p.m. for generators up to 60,000 kva. As examples of large generators two units are cited of 60,000 kva. at 1000 r.p.m. installed during the war in Germany. The diameter of the rotor is 2.25 meters, so that the peripheral velocity at 1000 r.p.m. is about 118 meters per second. Such large dimensions required a very powerfully built axle and also a design in which the critical speed was higher than the operating speed. As a matter of fact, the axle weighs 36 metric tons. The teeth are provided with ventilating orifices through which air for cooling the rotor is driven.

The author distinctly states, however, that 60,000 kva. is by no means the limit of size for such generators, and theoretically it is by no means impossible to go considerably beyond that. In fact, he says that it has been established by calculation that generators may be built in sizes up to 160,000 kva. and the most serious obstacle in the way of accomplishing such constructions lies in the difficulty of the transportation of such huge machines by railroad, necessitating their assembling and, in particular, winding on the spot of installation, a process not always attractive.

The use of giant machines of 160,000 kva. at 1000 r.p.m. is suggested in a central station with six units, one being a standby. Such a plant would have a normal load of 400,000 kw. and a peak load of 500,000 kw., with a total output per year of, say, 2,000,000 kw. hr. Five such central stations would have been sufficient to satisfy the entire demand for electric power in Germany. For steam turbines driving these generators are suggested double units with steam admission in the middle, 16 to 17 atmos. pressure at the turbine inlet and 20 atmos. gage pressure on the boiler, with a steam temperature of 350 degrees Centigrade at the turbine inlet valve.

In view of the great consumption of fuel and water of condensation, it is obvious that economically such big plants should be located only near a large coal supply and also near a large river. Assuming that coal would be delivered 300 days in the year, this would mean that 7500 tons per day would have to be received into the plant and be distributed either to the boiler rooms or to the bunkers.

The general conclusion to which the author comes is that at present the limit to the size of electrical generators is set mainly by the demand for power.

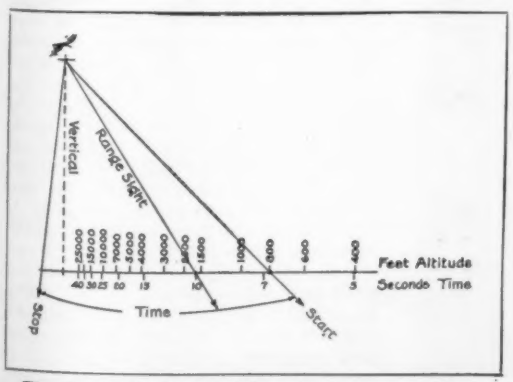


Fig. 8. Method of sighting, involving use of an altitude and a time scale

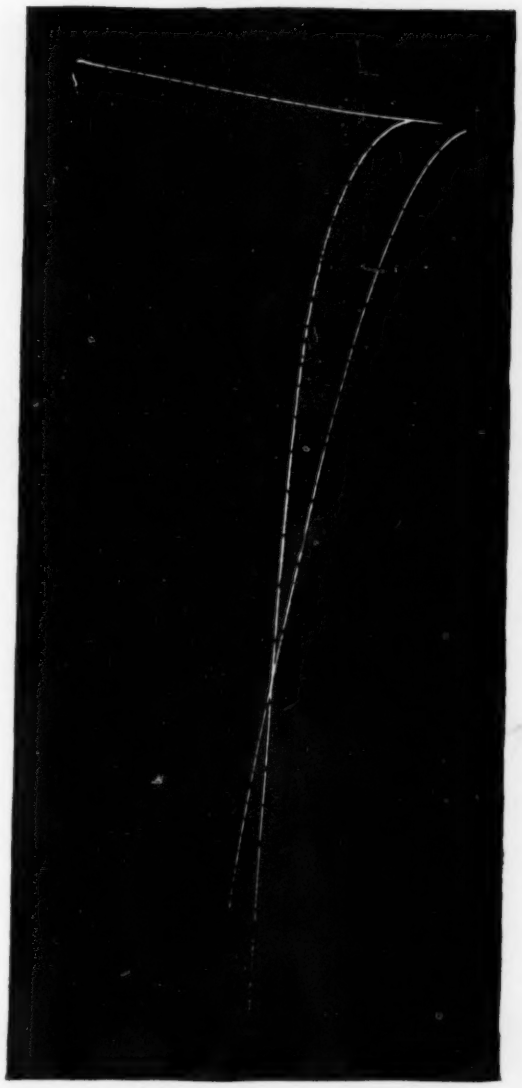


Fig. 9. Night photograph by Dr. A. W. Duff, using a storage battery in the bomb and an electric light on the tail. Note that the bomb that is wobbling—probably "cartwheeling"—loses its forward velocity more quickly, and finally falls in a nearly vertical path. Full breaks in the lines indicate seconds. The bright points are stars

Fig. 11. Three bombs dropped from an airplane. Note the true trajectory of the upper bomb and the "nosing up" of the two lower bombs. Accurate bombing not only requires that a bomb take a certain path, but that it always takes the same path

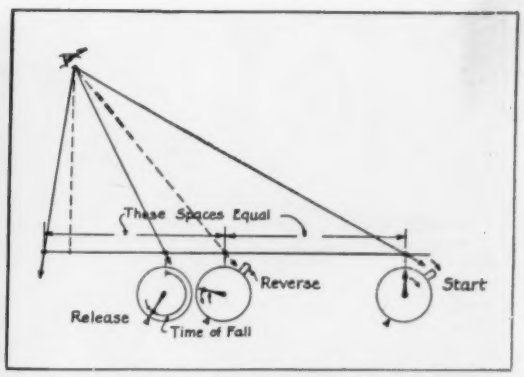


Fig. 7. Diagram illustrating the "equidistant method" of sighting

What Is Gray?

A NEW publication, Scientific Paper of the Bureau of Standards, No. 417, entitled "The Spectral Distribution of Energy Required to Evoke the Gray Sensation," has just been announced. The chief significance of this paper lies in the development and testing of an experimental method for determining an objective physical standard of "white light."

Experimental results are given from four observers. The average results of these observers indicate that "white light" may be represented: (1) Theoretically, by the light from a Planckian radiator at a temperature of 5200 degrees absolute; (2) practically, to a fair approximation, by average noon sunlight at Washington. It is, however, emphasized that the final establishment of such a standard should be based on a more extensive statistical investigation.

An appendix to the paper sets forth the desirability of an extensive statistical determination and correlation of the characteristics of color vision. This publication is now ready for distribution, and any one interested may obtain a copy by addressing a request to the Bureau of Standards until the free stock is exhausted.

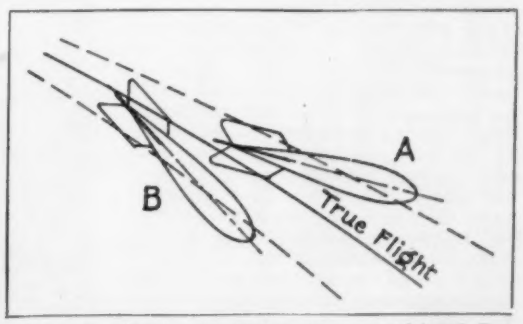
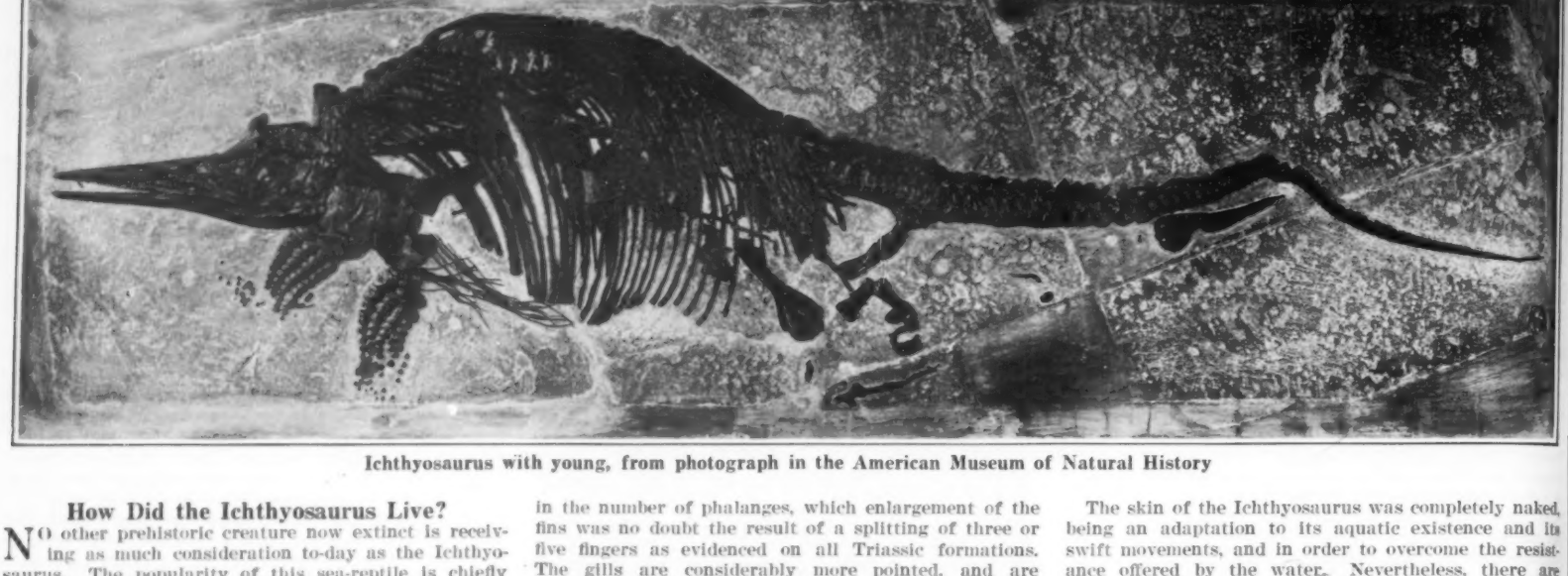


Fig. 10. Showing bomb A nosing up and bomb B nosing down



Ichthyosaurus with young, from photograph in the American Museum of Natural History

How Did the Ichthyosaurus Live?

NO other prehistoric creature now extinct is receiving as much consideration to-day as the Ichthyosaurus. The popularity of this sea-reptile is chiefly based on the fact that numerous well-preserved fossils are constantly being found. In certain sections of the slate-quarries in Holzminden and other parts of Wurttemberg, they are found in such large numbers that one can almost be procured as desired. It is for this reason that Germany's geologic collections comprise such complete and interesting specimens of a now extinct past.

In view of the wealth of fossil material available for investigation and comparison, the scientist was enabled to study every detail of the bodily structure of this sea-monster. The scientist was also enabled to determine to a large extent its habits of life by means of a comparative study of existing creatures, whose bodily structure resembles that of the Ichthyosaurus.

The Ichthyosaurus appeared chiefly in the Jurassic and Cretaceous formations in Europe, as well as in the Upper Jurassic strata of America to Greenland in the North, and likewise in the Upper Triassic formations of Europe. Individuals 10 meters long were then a common occurrence, lived exclusively in the sea, and consequently might be considered to have adapted themselves to this life to a very high degree. Undoubtedly they were descendants of some land-monsters, although their bodily structure shows they were utterly incapable of moving about on land, but spent their lives exclusively swimming about in the water. In addition to their bodily characteristics, which show adaptation to an aquatic existence to a high degree, their method of reproduction is evidence of this fact. Sufficient proof exists that they were born alive. A total of 14 bodies of Ichthyosaurus were found with young ones in their bodies. Considering the condition of the young ones in a number of these specimens the process of birth became problematical, in view of the fact that many of these young ones were facing each other. Both Owen and Quenstedt expressed the belief that the Ichthyosaurus frequently ate their young ones. Branca deserves the credit of having definitely established the truth of this assertion by X-raying a Berlin specimen.

The Ichthyosaurus possessed a long-tailed head, which was joined to the spindle-formed torso practically without a neck, a fact which enabled the monster to skim through the water with practically no resistance. Undoubtedly, through bodily structure and limbs, they must have been the best swimmers among the sea-animals of that time. They possessed very short limbs of a finny structure. The hind rudder-organs showed weak development, since locomotion was obtained by means of the two lobulated tail-fins, acting in conjunction with a rather high back-fin as keel.

In the structure of the skeleton of the limbs we find proof of a striking increase in the number of phalanges, which enlargement of the fins was no doubt the result of a splitting of three or five fingers as evidenced on all Triassic formations. The gills are considerably more pointed, and are equipped with a set of teeth, set in a common groove, the possession and formation of which give proof of the dangerous predatory instinct of these monsters. Large circular bony plates protected its eyes against the water-pressure at great depths, for the Ichthyosaurus, like the whale, was an unusually good diver. They lived chiefly on cuttle-fish (Belemnites) and fish. In the upper Jurassic formations we find forms equipped with considerably fewer teeth. This reduction in the number of teeth is unquestionably due to the increasing numbers of soft-shelled cuttle-fish which developed at that time and which formed their main diet.

A peculiar characteristic of one completely fossilized specimen is a semicircular throat-sack, whose function has not yet been determined. Perhaps it served a purpose similar to that of the human larynx, or of a box which had some connection with its absorption of food.

Adult and infant ichthyosaurus, as restored from the fossil remains of the German fields

The skin of the Ichthyosaurus was completely naked, being an adaptation to its aquatic existence and its swift movements, and in order to overcome the resistance offered by the water. Nevertheless, there are traces of armored limbs (Panzerresten) to be found on the front and hind fins, which give proof of the fact that its land predecessors were armored.

In the black Lias strata of Swabia several specimens with well-preserved skins were found, on which the outlines of the present tail-fins are completely retained. These fins are vertical in position; that is, they are joined symmetrically even with the body. The vertebral column shows a pronounced curvature in the region of the tail, which is indicative of the function of the tail-fins as organs of locomotion.

In their outer appearance the Ichthyosauri remind one very much of the Delphine mammals. This correspondence can only be accounted for by necessary adaptation to a similar mode of living. Among other characteristics its simple vertebral head bespeaks its monstrous nature. Bony ventral ribs covering its thoracic cavity, unquestionably enabled it to take in large quantities of air in diving into the depths, for one must assume that breathing took place through the aid of the lungs.

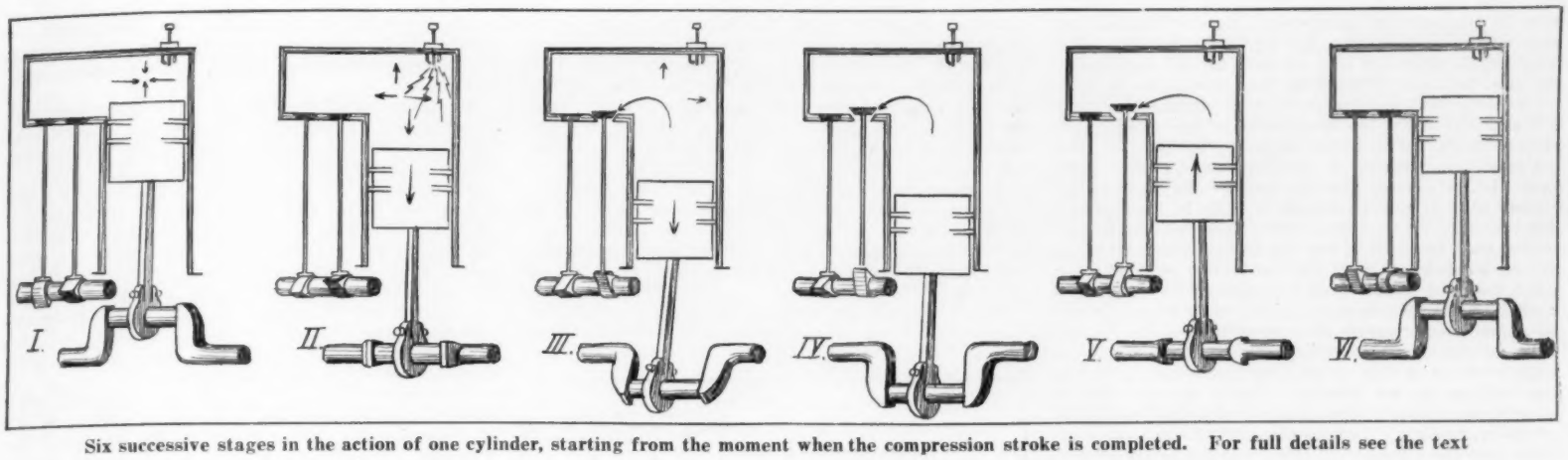
The large numbers of fossilized specimens found prove that these animals led a gregarious existence, and that, like the whales, they moved about in large schools. Whether or not they are to be considered as having been the sole inhabitants of the high seas, Solenhofen's discoveries prove that they even ventured into shallow bays.

This reptilian family flourished in the period of the Liassic Formations, the most important feature of which is the large number of different specimens of Ichthyosaurus and other reptilian remains. In the Upper Jurassic strata they become rarer, and rarer still in the Cretaceous rocks. Not a single Ichthyosaurus remains from the Tertiary Period. It must accordingly be assumed that this reptile became extinct in the Upper Cretaceous formation.

Development of the Asbestos Industry in Canada

A RECENT discovery was made of asbestos-bearing rock which gives promise of being of considerable value. Consul Norton F. Brand in a recent report states that the deposit is located in the serpentine rocks of the Canadian Pacific Railway connecting Revelstoke and Arrowhead and is about four miles north of Arrowhead.

The Montreal *Daily Star* recently announced that a large manufacturing plant for making asbestos products is about to be constructed in the Province of Quebec. According to this article about 80 per cent of the asbestos produced in Canada has heretofore been exported to the United States, while nearly all of the Dominion's requirements of asbestos products has been reexported from this country. It is understood that asbestos constitutes about one-half of the mineral production of the Province of Quebec.



Six successive stages in the action of one cylinder, starting from the moment when the compression stroke is completed. For full details see the text

Intake, Compression, Power and Exhaust

Successive Stages Showing What Happens Inside the Motor That Drives the Modern Automobile

ONE of the popular features of automobile shows of recent years has been the display of engines cut away in some manner and driven by electric power from outside, to display the successive steps of the engine cycle. There are always half a dozen of these exhibits, and there is always a good healthy crowd in front of each. We cannot believe that the people who go to the automobile shows lack acquaintance with the fundamentals of the internal combustion engine; yet they stand by the hour watching these exhibits turn over with their internals exposed. When the author of "Helen's Babies" put the words "I want to see the wheels go 'round!" into the mouth of little Taddie, he demonstrated the poet's statement that the child is father to the man, and gave expression to one of the dominating impulses of the civilized *homo sapiens*.

This, we believe, is sufficient justification for the pictures and text that occupy these two pages. Few of our readers are in ignorance of what we tell here. On the other hand, the things that experienced drivers do and say make it plain that all the niceties of the engine cycle are not universally appreciated. And even the reader who finds nothing here which had failed to impress itself upon his consciousness will, we hope, take a certain satisfaction in just watching the wheels go 'round.

The first attempts to make an engine which should be driven by the direct power of an explosion taking place in its cylinders, without the intermediate agency of steam to convert the heat of combustion into power, were disorderly and unsuccessful mainly because they failed to take into account the fundamental necessity for compression. A proper mixture of air and gasoline is explosive under all circumstances; but at atmospheric pressure it will not produce power to do a great deal of work. It is for this reason that Beau de Rochas, who first laid down the orderly sequence of strokes set down in the title above, is often recognized as the grandfather of the modern four-cycle engine.

Our first series of drawings attempts to follow these four parts of the cycle through in a single cylinder. We take the carburetor for granted, assuming that a means is present for supplying to the intake manifold a proper explosive mixture. We start, in Drawing I, at the point where the cylinder stands at top dead-center after the completion of the compression stroke. This cylinder stands now on the verge of doing work; the gas above the piston is under compression as indicated by the in-turning arrows, and all is in readiness for the spark.

For the moment we shall take the spark for granted, too, and rest secure in the confidence that when it is due it will arrive. Drawing II shows the next stage; the spark has occurred, the gas in the cylinder has exploded, and the arrows indicate that pressure is being exerted in all directions. An explosion, be it noted, can take place in a closed chamber without anything of note happening. A certain definite pressure is produced, and if all the walls are able to withstand it they will do so, and it will be contained. In the present case, all the walls of the combustion chamber are amply able to contain the explosion, with the single reservation that the floor of this chamber, furnished by the piston, is movable. The expanding gases take the vent that is open to them and drive the piston down. Drawing II shows it on its way, moving downward as indicated by the arrow. The "throw" of the crankshaft, which a moment ago stood straight up, has been pushed around and now stands straight out in front of the plane of the paper. The camshaft, which makes a single revolution to two complete turns of the crankshaft, for a reason to be demonstrated later, has made one-eighth of a turn to match the quarter-turn of the crankshaft; the cams are in correspondingly shifted positions.

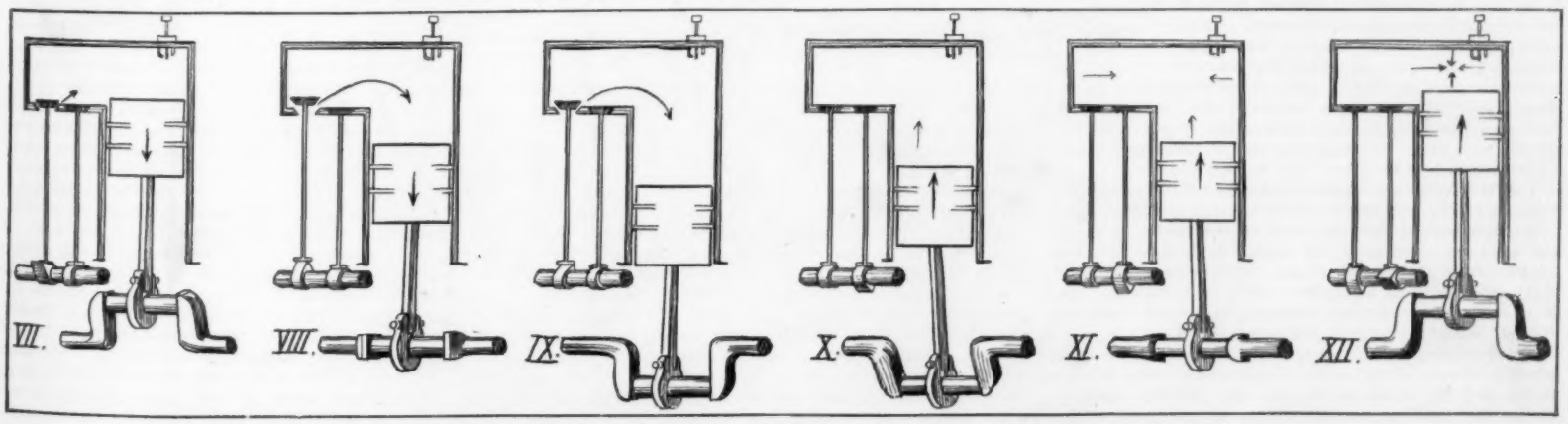
In Drawing III we are within a quarter-inch or so of bottom dead-center. The exhaust cam has moved around far enough to have started to raise its push-rod and with it its valve. With the crankshaft throw so near its own dead-center, the piston can not exert much push on it in any event; the infinitesimal amount of power lost by what might at first blush seem the premature opening of the exhaust valve is more than compensated for by the acceleration given to the exhaust process by this early opening. For there is going to be a real loss of power if we attempt to explode the next charge, when its time comes, without having cleaned out the burned gases thoroughly. In this drawing we still have the gases in the combustion chamber expanding, pushing in all directions, and incidentally passing to some degree out through the partly opened exhaust valve and thereby lightening the task which the piston must perform on its upstroke.

Drawing IV shows the piston at the end of its downstroke, at bottom dead-center; and the exhaust valve is open a trifle wider. The piston will not move any further, so that the cylinder is impervious to the expansive force of the gas save at the one point where we are only to glad to have it yield—at the exhaust valve. The only action of note that is taking place in the gas is therefore its continuing escape through this valve.

In Drawing V the piston has gone well along on its upward stroke; we see the crankshaft throw up and out behind the plane of the paper. This is the exhaust stroke; the gas may still have a certain amount of expansive action left in it, but that is immaterial. The piston is actively engaged in driving it up and out, through the now wide-open exhaust valve, the heel of the cam (in a cam of this shape it seems as though it might better be designated the toe) being at its highest point.

The sixth sketch depicts the next significant stage. The piston has again reached the dead-center at the top of its stroke, and the absence of an arrow to indicate its direction makes it plain that it is again momentarily checked. The exhaust valve has closed completely, in anticipation of the opening of the intake valve which is to follow. At the stage shown here, nothing is happening in the chamber above the piston head; the exhaust has been completed, the intake has not started. So we have no gas flow at all, and no arrows to indicate any.

As soon as the piston starts its downward stroke the intake valve of course must start to open, in order to get the full benefit of the suction from the motion of the piston. Drawing VII shows that this condition is met; Drawing VIII shows the intake stroke at its center, with piston and crankshaft in about the same position as in Drawing II, but with the cams and the valves quite otherwise; and Drawing IX shows us at the end of the stroke, at bottom dead-center again. Here we are about to start up on the compression stroke, and it might seem that the intake valve should have closed in expectation of this. The fact is, however, the in-drawing force at the valve is so persistent that we can afford to permit the closing of the latter to drag along a wee bit into the compression stroke; it need not close completely until the gas in the cylinder shall have had



The rest of the cycle, carrying things through to a duplication of the state of affairs seen in Drawing I, above

time to transmit the compressive force of the moving piston from the bottom to the top of the cylinder. But Drawing X shows us that as soon as any appreciable distance has been travelled by the piston in its upward, compressive way, the intake valve is seated. Drawings XI and XII show the completion of the compression stroke, and bring us to the beginning again.

Careful comparison of Drawings III-VI with numbers VI-X will show that the intake valve and the exhaust valve do not correspond exactly in their action. The exhaust opens before the piston reaches bottom dead-center, and is closed at the instant when it arrives at top dead-center. The intake valve, on the other hand, opens a shade after top dead-center and closes a shade after bottom dead-center. This result, it will be appreciated, requires that the two cams be set, not at exact right angles to one another, but at an angle a trifle wider than this, so that the intake action follows the exhaust at an interval slightly greater than a quarter revolution of the camshaft or a half revolution of the crankshaft. As here pictured, the two valve actions take the same actual time; and the action of each valve in opening takes the same period as the action of the same valve in closing. If it were desired to depart from these conditions, the periods of the valves could be made to differ by having the intake and the exhaust cams of different shape; while the half-periods of a single valve could be made to differ by having the cam unsymmetric—sloping more sharply on one side of the heel than on the other.

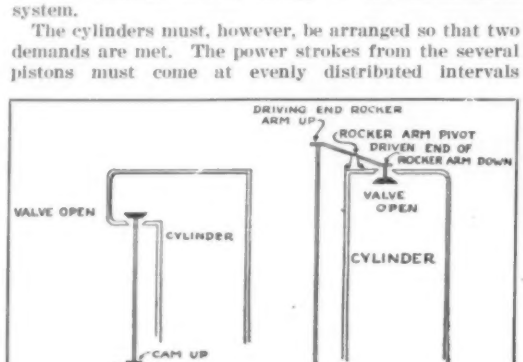
The valve action and the shape of the cam have been copied, in these drawings, quite faithfully, from a particular engine of a particular brand of automobile. Aside from this, it will be realized that liberties have been taken in the drawings, which are rather crude in a number of respects. In particular, the alcove that carries the valves is not, in fact, in front of the cylinder chamber, or behind it, but in every engine is actually at one side; so that the valves stand side by side in the direction parallel to the crankshaft. For simplicity of drawing we have turned the alcove around, and at the same time so pictured the valves that they may both have their push-rods resting on the cams of the single camshaft. Of course no sane designer would set up his engine in such a way that the intake would have to pass across the exhaust valve, covering a superfluous distance of two inches or more. Other departures of our drawings are likewise made in the interests of clear diagrammatic representation, and will be so understood.

We have shown the valves on our typical cylinder as of the poppet type. More and more, engine-builders are availing themselves of the advantages of the overhead valve in the top of the cylinder casting, so a word ought to be said about this. Its big feature is that it eliminates the alcove, and makes it possible for the intake and the exhaust to proceed without running around a corner. The incoming gas enters the main body of the combustion chamber at once; the exhaust gases leave that chamber directly via the valve. Curiously enough, the introduction of the overhead valve requires no modification of the cam setting, in spite of the fact that the valve-head must move downward to open and upward to close, in reversal of the poppet-valve action. The push-rods are merely made longer—sufficiently long, in fact, to project into the clear on top of the cylinder casting. A rocker arm is then provided, running from the end of the push-rod to a short valve stem. When the push-rod moves up, this rocker drives the valve down; and, as our drawing inserted for the purpose shows, the two styles of valve are in precisely the same position for the same position of the cam. It is even possible to introduce a lever-ratio effect by allowing the valve end of the rocker arm to be longer, from pivot to bearing point, than the driving end that bears on the push-rod. In this way the valve travels faster than it can with the direct drive from the push-rod, and so may open wider without any loss of time.

The action of a single cylinder is by no means all there is to the automobile. The several cylinders have to be so arranged that they will all contribute, in equal share, to the driving of the shaft. It is here that the fundamental divergence comes in between fours and sixes, and between all-in-line and V-type engines. We have not space to picture them all, and must therefore content ourselves with a few generalities.

Every piston, it will be realized from what we have already shown, must make two complete return trips down and up again in its cylinder for its complete cycle; and that means that the crankshaft must rotate through two complete turns for a single cycle of the cylinder. In other words, the individual cylinder delivers a power stroke not once on each turn of the shaft, but once on every two turns. This is the feature that separates the four-cycle engine from the steam engine and the two-cycle type generally, where work is done on both sides of the piston so that a power stroke is delivered on each revolution of the crankshaft. Pursuing the matter further, this is the reason why the four-cycle engine is always a multi-cylinder affair. A single cylinder can hardly deliver enough energy on the work stroke to carry the crankshaft through a turn and a half, drive the piston through three parasitic strokes, and in addition deliver energy to the transmission system.

The cylinders must, however, be arranged so that two demands are met. The power strokes from the several pistons must come at evenly distributed intervals



The relation between valve-head and cam is exactly the same in both types, despite the reversed direction of opening

Poppet valve vs. overhead type

through the two revolutions of the crankshaft that correspond to the single cycle of the entire engine; and they must be so distributed spatially along the shaft, from front to back, as to keep the latter evenly balanced. The latter condition is not so clear when expressed in words as the former; what it means may well be appreciated by a glance at our drawing of the complete four-cylinder engine.

It will be noted that here the two end throws of the crankshaft are shown down, with the pistons corresponding to them at bottom dead-center, while the two center throws are up, at top dead-center. This, it will be understood at once, results in an even distribution of the up and down moments about the center bearing of the crankshaft. If, without proper thought, the cylinders were allowed to fire in order from front to back, the first and third throws would be down while the second and fourth ones were up, and the unbalanced pressures would destroy the center bearing in short order, if not the crankshaft in the bargain.

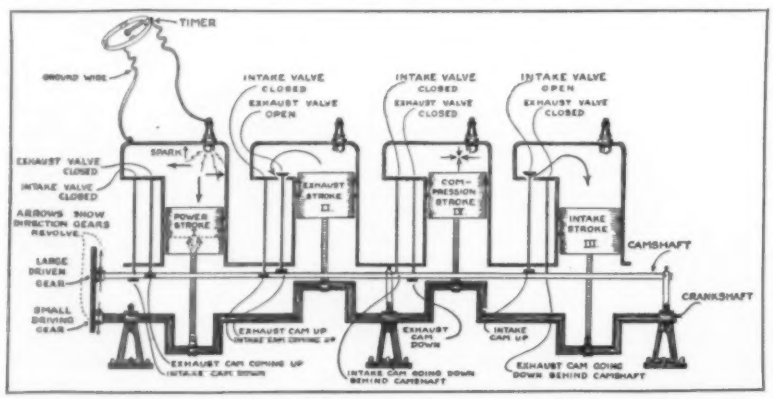
The six-cylinder engine, of course, presents three explosions and three power strokes for each turn of the crankshaft, while the four-cylinder type presents only two. This means that where the successive cylinders in the four (in order of firing, not in order from front of the engine to back) have their crankshaft throws exactly opposite one another at angles of 180 degrees, the corresponding angle in the six is 120 degrees. The great advantage of the six inheres in this circumstance; for where we show the four with all pistons at dead centers simultaneously, this cannot happen on the six, which must always have at least four of its six cylinders somewhere in the middle of a stroke, with never more than two of the six at a dead-center. This explains why the light six-cylinder cars make gasoline-mileage practically equal to that of the best fours, while the eights and twelves of necessity base their extreme smoothness of operation upon a larger consumption of fuel.

We have selected the four for full diagrammatic representation of the entire engine-cycle, and have retained the conventionalized crudities that make for more convenient diagramming. We are now able to show the relation between the crankshaft and the camshaft. The driven gear at the end of the latter is twice the size of the driving gear at the end of the former, so that the camshaft turns once while the crankshaft turns twice. Reflection will show this to be a necessary consequence of the four-stroke cycle; it could be avoided only by the use of separate camshafts for intake and exhaust valves. Arrows emphasize the fact that with a simple gear arrangement like that pictured, these shafts revolve in opposite directions.

No comment is necessary upon what is taking place in each cylinder individually, since in every case one of the stages shown in our first twelve drawings is reproduced. The point here is rather to exhibit clearly the succession of power, exhaust, intake and compression; as well as the succession of power strokes through cylinders 1, 2, 4, 3 when numbered in accordance with their position along the axis of the engine. The cams have been still further conventionalized, and this time the arrangement of all eight of them appears.

No effort is made to indicate the manner in which the timer or distributor, for producing the spark at the right time in the right cylinder, is geared or connected by chain to the ultimate source of its driving power. It, like the camshaft, must rotate once to two turns of the crankshaft; it may be driven by one-to-one gear off the camshaft gear, or by a similarly geared chain off the camshaft. The point in showing it at all is to indicate a little more clearly where the spark comes from. Assuming that we have a sparking current in the wires, it is plain that as the brush passes over each contact, this current flows to the plug in the corresponding cylinder and there gives the spark. We show only the wire leading to the cylinder that is actually firing.

The distributor is the one element in the timing of the engine that is flexible (as the spark-lever indicates). The slower the engine speed, the further the spark must be retarded to give the maximum of power; the greater the engine speed, the further it must be advanced in the same search for maximum force. Perhaps the reason for this is not clear to every driver. Reflection ought to make it plain that the slowing or speeding of the engine does not in the least affect the relative timing of pistons and valves; it affects only the actual values of their several speeds. On the other hand, the combustion and explosion velocities of a mixture of air and gasoline are entirely definite, and nothing we do to the engine can affect them in the least. When we slow the engine, or speed it up, we therefore *do* alter the ratio between the piston speed and the speed at which the gas acts in the combustion chamber. If we slow the engine materially the explosion takes place at the same old speed and will reach the piston head and begin to do work thereon before we are ready for it to do so; to prevent this, we retard the spark and start the explosion later. When we speed up the engine beyond the velocity of gas explosion, we similarly must advance the spark in order to make certain that the expanding gas shall reach the piston head soon enough.



The essential features of the full cycle of the four-cylinder engine, shown in diagrammatic form (cylinders numbered in order of firing)

The whole sequence of events that take place inside the gas engine is admirably designed to bring out the true significance of minute intervals of time. The Greeks had their celebrated paradox of Zeno, which was a permanent puzzle to them because, admitting the possibility of dividing space again and again and again into as small intervals as we choose and admitting the reality and the significance of the parts into which it might thus be divided, they refused to divide time similarly into indefinitely small pieces. We are apt to share this feeling that there comes a point beyond which further shortening of the time dealt with lacks significance. If we will but reflect that pistons make up to 2000 trips up the cylinder, and 2000 trips down it, and 4000 dead stops and reversals of direction, in 60 seconds, we ought to be convinced of the reality of minute time intervals. There is time, and to spare, for the proper sequence of all the things that must take place to complete a complicated engine cycle which lasts for but 6 one-hundredths of a second—even when the item under consideration is the halt at dead-center which can only be allowed a small fraction of this already minute period.

Trolley Snow Sweepers

BY means of new devices, Cincinnati street car tracks and streets are to be kept free from heavy snows and coatings of ice which in the past have proven big obstacles to traffic. They have been officially adopted by the Cincinnati traction company, and formally approved by those city officials having supervision over the company.

The new equipment consists of seven cars equipped with snow-pushing "wings" which are 12 feet long and when spread out for action clear a width of 7 feet outside the car track. These "wings" are also equipped with extensions of heavy steel folded over like a jack-knife which when opened up clear several additional feet. This contrivance may be termed a "mopper-up" and clean the street for the benefit of other traffic.

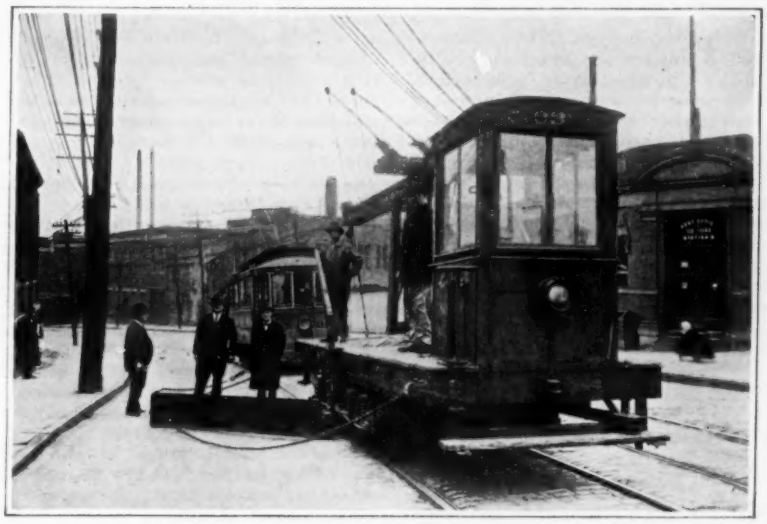
The scraper that clears away ice and frozen snow

Another piece of equipment is a large car provided with an apparatus for the removal of ice. On the front of this car is attached an apron provided with steel teeth, for the cleaning of ice from the tracks, which forms after snow melts. This machine, it is said, will do the work of 200 men. It is also planned to equip trucks with "wings" for use on streets where there are no car tracks.—*By R. C. Kroger.*

Electric Service Continued while Duct Line was Lowered

IN Minneapolis recently a two-line underground duct was lowered 12 feet through a total length of 1100 feet without any interruption to the electric service. At the point where this work was accomplished the roadway was depressed 12 feet in the process of eliminating a grade crossing, and the suspension method of lowering the ducts was resorted to in order to gain continuity of service.

The street was cut away on either side of the ducts to the required grade and then the ground was cut away from under the ducts at 10-foot intervals. Under the ducts a trestle of cross-ties and uprights was erected in the openings and two sets of planks were placed on edge on top of the trestle parallel to the road. Bolts passed between the two timbers carried a nut and washer and this formed a carrying support for the ducts. Short cross-ties were slipped under the duct line a short distance apart and a loop of guy wire was passed around each end of a tie and on through a pivoted eye on the lower end of the bolt. All the bolts were adjusted to take up the tensions, and the remaining earth was removed with a scoop shovel. Then the ducts being in complete suspension were ready for lowering. To lower the lines the nuts on every other pair of bolts were given three turns and then the alternate supports were lowered by three turns of the nuts. Upon reaching the bolt ends the nuts were taken off every other pair of bolts, and the guy wire loops were lengthened out by about the length of the thread on the bolt. After the bolts were placed back the nuts were screwed down to take up the strain. This process was repeated until the ducts had reached their new level. Then the bolts and loops were removed and the trestle demolished.—*By Allen P. Child.*



Using the trolley sweeper to clear snow from the roadway

Daily News and Concerts by Radio Telephone

THE Westinghouse Electric and Manufacturing Company announces that it has opened a radio telephone broadcasting station at its plant in Newark, N. J., and, with the cooperation of the *Newark Sunday Call*, is supplying news and concerts which can be heard by wireless operators within a radius of 200 miles.

Every night beginning at 8:05 Eastern Standard time, an entertainment consisting of a digest of the day's news, Government reports, and a musical selection is given. A special feature of the entertainments is a children's hour every Friday night at 7 o'clock, when songs and stories for the youngsters will be radiophoned.

During the World Series baseball games, every ball, strike, and other play was reported as soon as made from this station, so that thousands were able to enjoy the games. Similar service will be provided for the major football games and other important sporting events; the fact that these occur strictly on schedule makes them more eligible for such treatment than the more serious news of the world. Elections, however, can always be covered, as can market quotations, important court decisions, big sporting events and anything else that happens on fixed schedule or at a time known in advance.

The Westinghouse Newark station operates on a wave length of 360 meters, and its call letters are WJZ. It should be easily heard as far south as Baltimore and as far north as Albany; while under favorable conditions, the messages should be audible in practically the entire area east of the Mississippi River, and as far afield as the Bermuda Islands.

Lowering the electric-line ducts without interrupting the service

Testing of Thermometers

THE previous edition of this Circular of the Bureau of Standards contained, in addition to the testing regulations, much general information on thermometry and temperature measurements. The present, or third edition of Circular 8, has been very much shortened by including only the information which is essential to those who avail themselves of the Bureau's testing facilities. The Bureau's standard scale of temperature is defined and the method of reproducing it is briefly indicated. A new feature of the circular is the inclusion of definite testing requirements and of tolerances as to correctness of graduation. Thermometers meeting the requirements as to suitable design, material, and workmanship will, if found correct within the established tolerances, be certified, others will receive reports giving the result of the test. Notes on the behavior of thermometers which are included in the circular are intended to give the user of these instruments the information necessary for an intelligent application of the results of the test. Explanations are given of the reasons why the applicant for test must assume all risk of breakage either in shipment or test. The circular contains general instructions concerning packing and shipping and schedule of fees for testing.

The circular may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C.

Zinc Cyanide Plating Solutions

ZINC coatings furnish by far the best protection from corrosion of steel, and for this reason zinc plating or electrogalvanizing was extensively applied to all sorts of machinery during the war. Satisfactory zinc deposits can be secured from either sulfate or cyanide solutions, but the latter possesses the advantage of "throwing" the deposit better into deep depressions or upon the surface of irregularly shaped articles. The cyanide solutions were, therefore, given first consideration in the investigations conducted by the Bureau. It is hoped later to extend this study to include the sulfate solutions. It was found that satisfactory zinc cyanide plating solutions can be made by using zinc oxide to replace part or all of the zinc cyanide formerly employed for this purpose.

Technologic Paper No. 195 of the Bureau of Standards describes the above work and gives formulae for satisfactory solutions and general directions for their use.

Concrete Tower for Dam Construction

OUR cover this month shows the concrete tower 172 feet in height which has been built to carry the mixture of concrete up to the different levels for construction of the Hetch Hetchy dam, from which a large part of California will ultimately be served with hydroelectric power. The dam is to be built in two sections, the first being 226½ feet above the stream bed, and the ultimate crest 312 feet high. As the dam goes up, the height of the tower will be increased correspondingly, so that at all stages of the work it will give ample pouring head.

The aggregate is delivered directly to the mixers by small locomotives. A narrow gage railroad was constructed running from the dam site along the side of the valley a distance of some 7,000 feet to a rock quarry at the foot of Wampama Falls.

Excavation was carried to a depth of 72 feet to provide a solid foundation for the dam, numerous pumps being required to unwater the site. These big towers add further evidence to the numerous text and pictures which have already served to give the readers of the SCIENTIFIC AMERICAN some idea of the magnitude of the whole undertaking.

Our artist has given a good idea of many of these phases of the work, and has shown how operations are conducted on a 24-hour basis with the aid of huge floodlights that draw their power from that part of the project already completed.

The Service of the Chemist

A Department Devoted to Progress in the Field of Applied Chemistry

Conducted by H. E. HOWE, Chemical Engineer

The Effect of Oils, Greases and Degree of Tannage on Russet Harness Leather

THE result of a series of experiments conducted at the Bureau of Standards is reported in Technologic Paper No. 160. The variation in tensile strength, stretch and buckle strength in leather from different parts of the hide is given for six sides of leather. It has been found that variations in the amount of oils, both mineral and animal, and of medium and heavy tannage, as well as the amount of stuffing, has a bearing on the physical properties and there is a point beyond which these materials do not add to the strength, and indeed may actually decrease it.

It was also found that the tensile strength is greater for leather tanned for a short time than for that given a long tannage. This also affects the firmness of the leather, the longer time tannage producing leather more resistant to sheer when used near a buckle. Mineral oils of the type used in the experiment did not affect the physical properties of new leather in any degree substantially different from animal oils.

Ductile Nickel-Cobalt

RESEARCH continues to uncover the reasons for the behavior of different compounds to such a degree that one can not fail to wonder why many industries or individual concerns in an industry hesitate to support research. For example, the alloys of nickel and cobalt have always been non-ductile at ordinary temperatures, but it has remained for Colin G. Fink to learn that this non-ductility is due to the presence of carbon in the alloy, and that when such a non-ductile alloy is freed from carbon, sulfur, phosphorus and basic impurities it becomes ductile. An alloy containing 20 to 30 parts of cobalt and 90 to 80 parts of nickel produced in an electric furnace using an alundum crucible under circumstances which preclude contamination with the impurities mentioned above and to which, when melted, two parts of manganese are added, may be rolled from one-half inch down to two one-hundredths of an inch without intermediate annealing. Such an alloy is suitable as a support or a current lead wire for electric lamps. It has low heat conductivity, and therefore increases the efficiency of electric lamps, particularly in the case of those of low voltage.

Waterproofing Paper

A BRITISH patent has been granted for a new method of waterproofing paper to such an extent that it may be used as a substitute for rubber or leather in making diaphragms for gas meters, etc., or for the manufacture of small articles like purses. The patent is abstracted in the October issue of *Chemical and Metallurgical Engineering* and states that the material is prepared by impregnating long-fibered paper with a warm solution of animal and vegetable glutinous substances. After drying, whale oil or a fat is rubbed into the treated paper. The long-fibered Japanese paper is considered preferable, and the following impregnating solution is considered suitable: Gelatine one part, arrowroot one part, potassium bicarbonate one-half part, calcium chloride or glycerine three parts, and to reduce flammability, three parts of ammonium carbonate are added. These materials are all dissolved in one hundred parts of water. When brittleness is not a factor, gelatine alone may be used, and the treatment with fat or oil alluded to above is necessary only when the material is to be subjected to alternate wetting and drying.

Coal Gas Composition

ANNALES DE CHIMIE for May and June report results of experiments by Vignon on the relation of temperature to the composition of gas obtained by the distillation of coal. In the series various coals were heated at 400, 600, 800, 1000 and 1200 degrees Centigrade, until only very small quantities of gas continued to come off at that temperature. A number of conclusions are reported. The unsaturated hydrocarbons distill below 600 degrees and are broken up at higher temperatures. The saturated hydrocarbons distill up to 800 degrees in large quantities; that is, up to 84 per cent, but this percentage diminishes rapidly at still higher temperatures. Most of the hydrogen comes off between 800 and 1000 degrees, and less than 10 per cent of the carbon monoxide comes off below 1000 degrees. When the temperature of distillation is increased a greater volume of gas is obtained, but this gas is of low heating value and contains on the average greater amounts of carbon monoxide.

The Value of Planting Trees to Supply Raw Material for Chemical Industries

NOT so many years ago it was considered necessary to establish a tannery in the woods where it could be near large supplies of the various bark required. More lately methods for preparation of concentrated tanning extracts were developed, and the newer tanneries have, in general, been placed with reference to easy access to a supply of hides and skins, to which it is cheaper to bring the concentrated extract than to transport the green hides to the bark. Part of this change comes about through the disappearance of suitable trees, and in Germany the Central Union of the German Leather Industry is now urging that more attention be devoted to the planting of chestnuts, not as a substitute for oak, but as a means for increasing domestic tannin production. The bark, as well as the wood, of the chestnut contains tannin, and one investigator has found that at the age of 15 to 25 years the chestnut will yield from 4 to 7 times as much tannin as the oak of the same age from oak plantations. The plan seems to be to replace the oaks as they are removed by setting out chestnuts.

While it is true that the present scarcity of wood or methyl alcohol in the United States is due in large part to the demand for formaldehyde used in the treatment of seeds, etc., and as a raw material in the preparation of organic accelerators for rubber vulcanization, it is also true that several wood distillation plants have been compelled to cease operations for lack of raw materials. Notwithstanding the efforts made on the part of the authorities and some private interests to practice reforestation, the subject seems to be one to which more attention is given in conversation than in actual practice. The development of different chemical industries in our country may bring added pressure to bear to accomplish the type of reforestation work which has long been advocated.

A New Cooperative Movement

UNTIL the organization of the Crop Protection Institute, under the auspices of the National Research Council, on September 28, following the preliminary conference held last June in Rochester, N. Y., there have been no adequate facilities for close cooperation between the various scientists interested in combatting injurious insects and plant diseases and those who manufacture the materials and appliances used in such work. The new Institute represents all of these groups, and through its activity it is planned to conduct regional conferences and cooperative experiments to the end that more rapid progress may be made in devising new methods for insect and plant disease control. None of the present work will be duplicated, but an effort at coordination will be made and there is every reason to believe that the public will eventually benefit to a marked degree.

The importance of such cooperative work may be emphasized by the work before us in controlling and if possible eradicating the bean ladybird. The insect has arrived from Mexico and is establishing itself among the leguminous crops of Alabama. Unless it can be controlled this insect threatens the bean crop of the United States. So far as we know now, the ladybird has no natural enemies, and as it clings to the underside of the leaf it is difficult to reach with sprays and dusts. Unlike most insects, two-thirds or three-fourths of the individuals are females, each of which may lay 750 eggs in a season. It is evident that to wage war on so dangerous an insect requires the fuliest amount of cooperation on the part of state and federal authorities, as well as others. The work of an insect of this sort could readily undo all that the bollweevil has taught the South concerning the benefits of crop rotation and the growing of leguminous plants on soil where the bollweevil makes cotton raising commercially impossible.

Renewing Worn Files

PUBLICITY has just been given to a method for renewing old files which consists first in cleaning them with a "file card," after which they are placed in a mixture of four ounces of washing soda and one quart of very hot water, in which mixture they are then scrubbed with a brush to remove oil, dirt, etc. The acid mixture to which the files are then transferred consists of four ounces of sulfuric acid in one quart of water. It should be remembered that when diluting sulfuric acid with water sudden heat is developed such that if the water is poured upon the acid dangerous spattering will occur. The acid should always be poured into the water very slowly and the solution stirred with a piece of wood or a glass rod. The old files remain covered in the solution for from 10 to 12 hours, after which they are thoroughly washed in water, dried, and oiled.

A Chemical Method for the Detection in Fruit of a Prior Frozen Condition

THIS is the subject of an interesting article by Dehn and Taylor in the October issue of the *Journal of Industrial and Engineering Chemistry.*

"Modern methods of cold storage of fruits sometimes raise the question whether too low temperatures have been employed, resulting in abnormal deterioration when the fruit is removed from storage. For example, pears are held at a lower temperature than peaches, and if both are held at the same temperature the peaches may be injured. The question arises whether fruit which has been frozen or only partly frozen can be distinguished from fruit not subjected to these low temperatures.

"Extreme cases of frozen fruit can, of course, always be recognized after thawing by the mussiness and darkening of the pulp, by the modified taste, and by the rapidity of rot. Between the extreme frozen condition and the non-frozen condition cases arise that can not be judged by such obvious indications."

The authors, therefore, undertook to devise chemical and other methods for the examination of fruits in such cases and found that advantage could be taken of divergencies in the largest components of the fruits, particularly the variation in the ratio between invert sugar and sucrose. Inversion subtracts from the sucrose concentration and adds to the invert sugar concentration, thus giving accurate measurements of such divergencies which can be determined by standard gravimetric methods of measurement. Sucrose is inverted during ripening, overripening, rotting and freezing, and the invert sugar itself may be destroyed by chemical decomposition, the metabolism of the plant or the action of yeasts and molds. Molds consume a large part of the invert sugar, or at any rate feed upon it rather than upon sucrose, so that should great deterioration take place in the case of the sample the method suggested is not reliable.

Other Meat

SOME months ago reference was made to experiments conducted by Trowbridge at the Experimental Station of North Dakota in utilizing horses beyond the effective work age as a source of food supply to supplement beef. He found that dried horse flesh from a horse, 13 years old was more tender and just as palatable to the average person as high-grade dried beef.

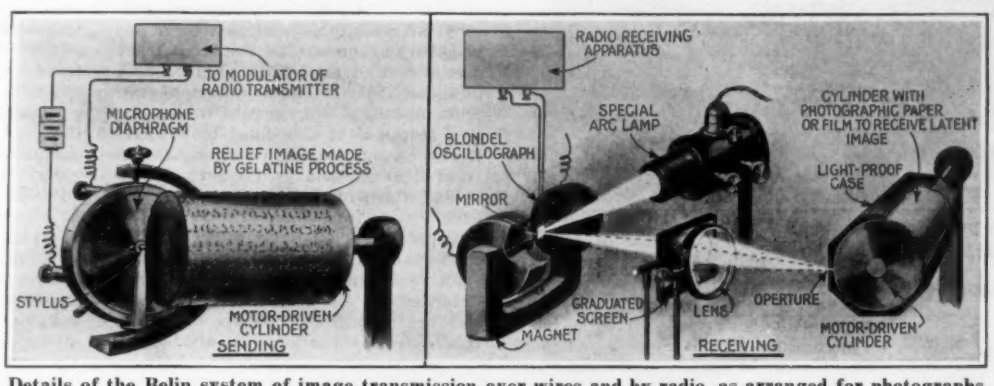
The Office of Home Economics, United States Department of Agriculture, has been working upon a comparison of the edible portion of the flesh of the kid, rabbit, horse, and seal, and it has been found that the digestibility of these meats, or of the proteid of the four kinds of meat, is substantially the same as that of any of the other, and better known, meats.

Whenever experiments of this sort are made we are reminded of the prejudices of the average consumer, but it was noted from the conversation of those partaking of the various dishes that those who were being treated to cakes of horse meat found nothing unusual about them, and thought they were a good variety of "hamburg steak."

Why Not Long-Distance Stenography?

THE usual dot and dash language comprising the Morse code of wire and wireless telegraphy is rather a crude piece of work. That is to say, it depends on the differentiation between dots and dashes and spaces, and even the slightest error in making a proper differentiation leads to serious errors in the transmission of dispatches. Obviously, it is a delicate language, this Morse code, especially in long-distance radio telegraphy where the receiving operator's ears must strain to catch the faint signals, or where the photographic recorder takes down the signals and parasitic disturbances with equal facility; and it is for this reason that there is so much repeating of messages in radio telegraphy, in order to insure accuracy even under the most adverse conditions.

The Belin system of image transmission over wires and via wireless may yet bring about a revolution in telegraph and wireless systems. For with this system it becomes possible to transmit images instead of mere dots and dashes, and there are far less errors possible with such images than with the delicate Morse code. Originally the Belin system was identified with the transmission of photographs over wires and even by radio, but it now appears as though the transmission of facsimile handwriting, typewriting, odd characters such as those of the Chinese alphabet, and even stenography may prove to be the more fruitful field in which to apply this ingenious invention.



Details of the Belin system of image transmission over wires and by radio, as arranged for photographs and other so-called half-tone subjects

The Belin system has been described in past issues of this journal, at the time when it was employed in transmitting photographs between St. Louis and New York City, and more recently when this system was employed in transmitting drawings from the Annapolis radio station to Malmaison, near Paris, France, and the facsimile handwriting of Premier Briand and General Pershing from the American-built Lafayette radio station, near Bordeaux, France, to Bar Harbor, Maine.

However, a brief description of this system is again given here, together with the accompanying schematic drawings which are virtually self-explanatory. It will be noted that the transmitting device consists of a motor-driven cylinder on which is placed the image to be transmitted. A certain process causes this image to form in relief on the brass cylinder. As this relief image is rotated, there presses against it the point or stylus of a microphone. Obviously, as the stylus is more or less pressed by the irregularities of the relief image, the current flowing through the microphone is likewise varied or modulated, thus giving an electrical interpretation of the relief image. This varied or modulated current can be sent over the wires of a telegraph or telephone line, or can be employed to control a continuous wave wireless transmitter.

The receiving end, which may be connected to a telegraph or telephone line or to a wireless receiving set, as the case may be, is somewhat more involved. As will be noted by studying the receiving side of the accompanying drawing, the incoming current is led to the fine wires of a Blondel oscillograph. These parallel silver wires, passing down between the poles of a powerful electromagnet, carry a small mirror, which swings on its vertical axis with the fluctuations in the current passing through the parallel wires. A beam of light from a powerful arc lamp is directed on the tiny mirror, which in turn reflects the beam on to a graduated screen. This screen is opaque at one end and transparent at the other, with varying degrees of transparency between both extremes. Obviously, as the mirror turns on its axis in response to the fluctuations of the incoming current, which in turn represents the varying values of black and white represented in the image at the transmitting station, it rests on the corresponding section of the graduated screen. More or less light, therefore, passes through the screen and through the lens at the rear which guides it to the aperture of a light-proof case. Inside the light-proof case is a motor-driven cylinder that carries a piece of photographic paper or film. Thus the varying values of light are impressed on the sensitized paper or film as it is revolved at the same speed as the cylinder at the transmitting end, an ingenious synchronizing device being employed for the purpose. The image is thus formed in a helix, so to speak, with the successive lines of the helix practically overlapping. It is the fineness of the threads of this helix that that determines the texture of the received photograph.

The process just described applies to the transmission and reception of photographs, in which all tones from black to white must be handled. The transmission of plain black and white matter, such as facsimile handwriting, type matter, drawings, maps and so on, is considerably simpler. The microphone is replaced by a plain make-and-break device equipped with a stylus, while the graduated screen is dispensed with at the receiving end. In this arrangement the stylus either makes or does not make a contact, and current either flows or does not flow through the line or through the radio transmitter. At the receiving end the mirror either turns so that the beam is directed into the aperture and on to the sensitized surface, or it does not turn, hence no light falls on the sensitized surface.

In view of the fact that long-distance radio stations are often tied up for hours at a time because of the atmospheric conditions which break up or muddle up the delicate dots and dashes of the Morse code, the Belin system is highly promising. In fact, M. Belin has given serious thought to the use of stenography in connection with his system. Thus a message to be transmitted could be written in shorthand, specially treated to bring it out in relief, and then placed on a drum for transmission. Instead of the delicate arrangement of dots and dashes the message would then consist of facsimile reproduction of the shorthand notes at the receiving end, which could be read off by a skilled stenographer. Even with atmospheric disturbances or "static" at its worst, there would be sufficient of each outline present in the received images unmistakably to read the messages. In the case of the telegraph code, the static breaks up the arrangement of dot, dash, and space, thus changing the entire meaning of the received signals, whether they are received audibly on a photographic tape recorder.

In the case of Chinese characters the Belin system is of greatest import. Chinese can not be spelled phonetically, as is the case with Japanese. Furthermore, it is practically impossible to form a sufficient number of dot and dash combinations to represent the hundreds of letters of the Chinese alphabet. Heretofore the practice has been to translate the Chinese dispatches into some other language that does admit of telegraphic interpretation, and to translate that language back into Chinese at the receiving end. An awkward and dangerous practice, true, but it was the best available. The Belin system now makes possible the transmission of the Chinese characters themselves, thus marking a vast stride forward for Chinese and all other languages which are to be handled in their original form over wires and wireless alike.

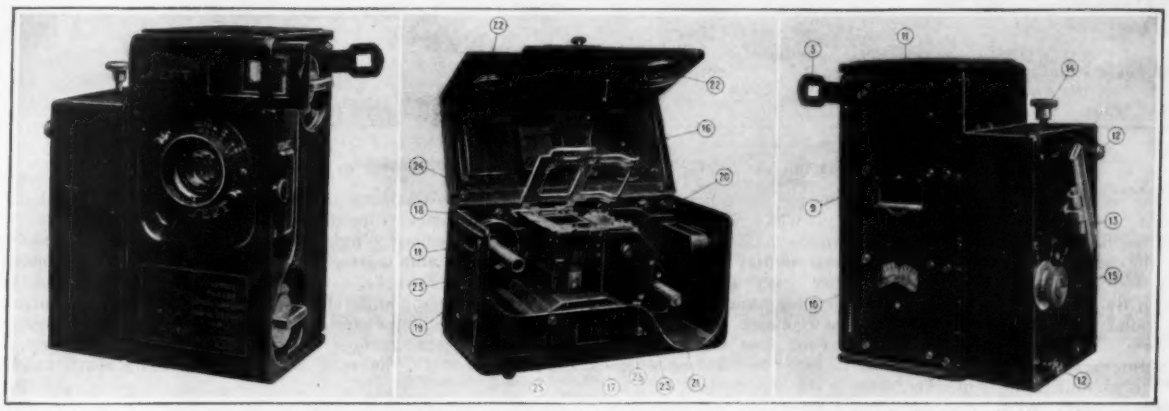
Production of Liquid Air

WHILE liquid air has been produced in the laboratory and on a commercial scale for many years, but little information is available in printed form concerning laboratory plants for its production.

Scientific Paper No. 419 of the Bureau of Standards has just been issued and may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 5 cents a copy. It appeals to anyone interested in the subject.

Combining Motion Pictures with Clockwork

FROM France comes an ingenious motion picture camera of compact dimensions. In fact, the little camera measures 4 by 5 by 6½ inches, yet it contains a highly finished mechanism capable of exposing 250 separate pictures on a strip of ordinary motion picture negative film 20 feet long, either in the form of motion pictures or as separate snapshots or time exposures.



Three views of an ingenious camera for making motion pictures and separate exposures, showing, respectively, the front; the inside of the camera proper with film gate, sprocket wheel and film-spool shafts; and the rear of the camera, showing the sliding shutter raised for focusing directly on the film or for enlarging, the counter indicating pictures exposed, clockwork mechanism, and knob that sets the mechanism for motion picture work, snapshots, or time exposures

A French camera that combines clockwork with motion picture mechanism so as to make an all-round hand camera

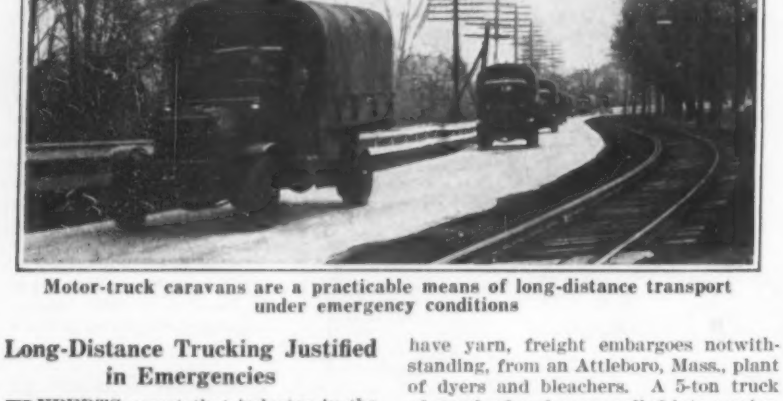
The entire mechanism of this new camera is automatic. The camera is made of metal throughout and consists of two parts: first, the camera proper; secondly, the mechanical motor attachment. The motor mechanism is of the clockwork pattern, and supplies the necessary mechanical energy for the taking of motion pictures or separate exposures. It is wound with a fixed key. The mechanism is released by pressing a button. An indicator at the side of the camera shows whether the mechanism is set for motion pictures, time, or snapshots. The film shifts automatically.

The camera is supplied with the usual motion picture lens, with an extreme aperture of 3.5 and a 2-inch focus. A view finder is provided on the left-hand side of the camera and can be used for either upright or horizontal pictures. To permit of the loading and unloading of the camera in daylight, the film is enclosed in a special box which opens and shuts in the interior of the camera by an ingenious attachment on the outside of the case. Other features are an indicator which shows the number of pictures exposed; a sliding shutter which allows direct focusing on the film and the using of the camera as an enlarger, a device for using the camera as a printer, and a screwhole with universal thread for fixing the camera on a tripod.

The Motor-Driven Commercial Vehicle

Conducted by MAJOR VICTOR W. PAGE, M. S. A. E.

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The editor will endeavor to answer any question relating to mechanical features, operation and management of commercial motor vehicles



Motor-truck caravans are a practicable means of long-distance transport under emergency conditions

Long-Distance Trucking Justified in Emergencies

EXPERTS assert that industry in the United States had outgrown the whole system of rail transportation until the recent setback. It will be years, they said, before the existing railway equipment can be restored to full efficiency and the extension of facilities necessary for the rails to "catch up" to the normal demands of business can be accomplished. During the acute shortage of cars which existed last year, business everywhere, with its customary resourcefulness, sought relief elsewhere. Cut off at the round house, it turned to the garage. Inter-city shipping by truck which under ordinary circumstances is included in the short-haul category, was commonplace and as ordinary as the motorization of hauling and delivery within the city.

As the demand grew, distances became longer and longer, until the 1000-mile mark had been passed in numerous instances. Now, the experienced truck maker and operator knows that under normal conditions there is no economy in truck hauls of such distances. Hence he would not recommend them except in cases of great urgency. However, many emergencies have come up in the past which sent motor trucks over the roads on long trips. The cost of these ventures was high, but shipper and consignee alike considered the expenditure an ultimate economy. We will point out a typical case.

In order to keep its factory running, a knitting mill in Delavan, Wis., had to have yarn, freight embargoes notwithstanding, from an Attleboro, Mass., plant of dyers and bleachers. A 5-ton truck of standard make was called into service. With a cargo of worsted yarns, valued at nearly $35,000, the truck set out on a scheduled round trip of 2300 miles. The contract price for the trip was $2888.25, or approximately $2.40 per mile one way —$1.20 per mile for the entire route. The emergency was met promptly.

Similar situations have been met in other parts of the country and raise the question whether such use of trucks, though involving increased expense, was not an ultimate economy. Suppose delayed shipments of raw material had been allowed to force suspension of production, with a consequent loss of time for employes. Very shortly, lost time and decreased production would have proven much more costly than the emergency use of trucks for long hauling of needed raw materials. Less tangible, but none the less real, was the danger of weakened prestige by failure promptly to fill certain orders, a danger that proved to be the closing factor in the decision of certain firms to use trucks.

Many Factors in Farm Haulage

HAULING farm produce to market in motor trucks represents one means of the successful solution of the "short haul," one of the most difficult problems which confronts the transportation expert. The failure of railroads to keep pace with the expansion of the short-haul business; the development of the producing areas adjoining the larger cities in proportion to the production demands asked of them; and the upbuilding of the motor truck manufacturing activities have popularized this method of moving farm produce.

Rural freight is hauled by the farmer who owns a truck and handles his personal marketing, as well as that of his neighbor, by motor; by the local truck operators who haul farm produce as a business; by the local automobile or truck agencies that operate transportation trucks as a side line; by the city transfer company which also engages in rural hauling; and by the large corporation which operates a fleet of trucks over a wide range of territory. Naturally there is a similarly wide range in the methods of doing business.

Farm-to-farm collection of freight is practiced on short rural routes where comparatively few stops are ordinarily made. Such collection is costly both in time and gasoline and hence necessitates higher rates. The cross-roads collection system is popular also, the shippers centralizing their produce at certain points where it can be loaded on the trucks. The central assembling method where the shippers concentrate their freight at one point or where a lighter, auxiliary truck collects and delivers it possesses many efficient features.

There are many different systems of computing rates and charges for hauling. There are several factors which should be considered in the establishment of rates in any district. The value and the fragility of the load bear a direct relationship to the rate that should be charged. The length of the haul naturally is a prime consideration. Road conditions directly affect operating costs and hence must also be considered in establishing rates. The perishability and bulk of the load must be taken into consideration. Where complete delivery is made from the door of the shipper to the door of the consignee, this must be considered in fixing the rate.

Left: Carrying boxes of garden truck to market. *Right:* 1½-ton trucks used by a dairy for collecting milk

Valuable service is performed for the farmer by trucks of his own or other ownership

College Girls Tour East in Truck to Raise Funds

SEVEN Simmons College girls have cruised the country this past Summer on a unique venture. The $2,000,000 endowment fund which their Alma Mater is out to raise is considerably richer by virtue of their efforts and enterprise. Having mapped out an itinerary designed to take them daily to new places where people congregate—to Summer resorts, carnivals and fairs—the seven girls chartered a 2-ton truck at Boston and embarked. From the well-stocked truck the Simmons seven sold creations of their own skill and originality, and a conglomerate stock it was. A partial inventory would reveal confections and cloth hats; silver and furniture polish made at the college; soap, woolen and knit goods; not to mention the famous Sally Simmons dolls.

Truck used by college girls in cruise to help the endowment fund

The Heavens in January

Some New Observations Upon a Stellar Object of Old Interest

By Professor Henry Norris Russell, Ph.D.

THE most interesting astronomical news of the past month relates to stellar matters. We may begin with a new chapter in a long and interesting history—that of Tau Corona Borealis, the new star of 1866. This object blazed out suddenly, of the second magnitude, on May 12th of that year, remained at maximum for only a day or two, and sank out of reach of the naked eye within a few weeks. As soon as its exact position had been determined, it was found that it was identical with a telescopic star, of the ninth magnitude or a little fainter, which had been observed years before by Argelander and listed in his great "Durchmusterung" catalog. This afforded the first evidence that these so-called "new stars" were not really newly formed bodies, but merely variable stars, previously existing, which had increased suddenly and enormously in brightness—a conclusion since confirmed in the cases of several other novae. This star, too, was the first nova to be subjected to examination by the spectroscope, which had just come into use in astronomy. Huggins detected in its spectrum the strong bright lines of hydrogen which are characteristic of the type, and from his drawings it appears that the spectrum was then very like that of more recent novae just after maximum. Within a few months the star had faded to about its original brightness, and it was almost forgotten by observers for half a century.

When half a dozen other novae had subsequently appeared and been studied, it was seen that this one was fairly typical, except in a few particulars. Unlike all the rest, which lay close to the Milky Way, it was forty degrees from the latter; and it was brighter before the outburst than any other temporary star yet recorded. Moreover, the paroxysm of brightness was unusually short-lived, enduring but a few months where other stars often have required years to return to their original states.

The only recorded observation of late years was by Miss Cannon of Harvard, who classified its spectrum as of the K type. Now most novae on fading exhibit a spectrum containing bright lines much resembling those of the "early" (or probably hot) stars of class O, and not at all like the "late" (cool) stars of class K. It therefore occurred independently to Dr. Lundmark at the Lick Observatory, and to Dr. Adams and the writer at Mount Wilson to photograph its spectrum with powerful instruments.

A Surprising Spectrum

The two observers agree perfectly in their findings, which are certainly remarkable. The spectrum is of an advanced M type—indicating about the lowest surface temperature which prevails among the stars—but is rendered unique by the presence of bright lines, not only of hydrogen, which would not be remarkable, but likewise of helium—and an advanced line of helium at that (λ 4684 on the ordinarily used scale), which requires for its excitation about as violent a degree of stimulus as any known spectral line.

Unexpected as these findings were, they do not appear inexplicable. There is very good reason to believe that the catastrophe which causes the outburst of a nova, whatever it may be, affects only the surface of the star, and that much of the disturbed material is actually ejected into space—as is indicated by the extraordinary expanding nebula observed around Nova Aquilae. The rest of the star, comprising probably almost the whole of its original mass, gradually reverts to something more or less like its original state before the disturbance. Now in the case of Tau Coronae the outburst was apparently less violent than usual—as is indicated by the rapidity with which the light decreased. Hence it is possible that fifty-five years later the star may have settled down to its original condition as a red star of low temperature. The bright lines of hydrogen and helium, on this hypothesis, may be attributed to the remains of the ejected nebulous matter—though it should be noted that the well-known nebular lines in the green are absent.

Stars of class M appear always to be either giants, much brighter than the sun, or dwarfs, much fainter. We may hope that Dr. Adams will be able to tell definitely from his spectra to which of these classes Tau Coronae belongs at present. It seems improbable that it is a dwarf, for then it would be very near us among the stars (twenty light-years or so), which does not agree with the absence of any considerable proper motion. If, on the other hand, it is a giant, it is now probably somewhere between ten and fifty times as bright as the sun. During the great outburst it was a thousand times brighter—which is indeed an enormous luminosity, though there is some evidence that Nova Aquilae may have been as bright. The whole affair illustrates strikingly what beautiful opportunities for discovery surround the observers with great telescopes. Adams' exposures on the star lasted only about three hours; Lundmark, with a smaller instrument, required the more heroic interval of some fourteen hours, distributed over successive nights. But even so, the game is well worth the candle.

A second interesting report comes from the University of Illinois, where Professor Stebbins has just completed one of those precise and admirably finished studies upon eclipsing variable stars for which he is justly famed. As in the rest of his recent work, he used the photo-electric photometer, an instrument of extreme precision, but demanding great manipulative skill. The object of his study was the star 1H Cassiopeiae (that is, No. 1 in Heis' list of the stars of this constellation), which is a star of the fifth magnitude, in the western part of the constellation, and may be found by carrying a line from Gamma Cassiopeiae through Beta, and extending it as far again, bending slightly to the left. It was discovered to be a spectroscopic binary in 1903, and was later found to have a period of slightly more than six days.

At 11 o'clock: Jan. 7.
At 10½ o'clock: Jan. 14.
At 10 o'clock: Jan. 22.

At 9 o'clock: Feb. 6.
At 8½ o'clock: Feb. 14.
At 8 o'clock: Feb. 21.

At 9½ o'clock: Jan. 29.

NIGHT SKY: JANUARY AND FEBRUARY

A New Eclipsing Binary

Among stars of this sort, which are known to have faint companions revolving fairly close to them, a considerable proportion are likely to have their orbits turned so nearly edgewise to us as to produce eclipses; and the present case is one in which Professor Stebbins' examination for such phenomena has been rewarded. Two well-marked eclipses occur during the period—well marked, that is to say, when the observations are as precise as those of Stebbins. The loss of light is only eleven hundredths of a magnitude at one eclipse, and three hundredths at the other, and would be quite imperceptible to the ordinary eye. The deeper eclipse lasts two hours, and the other about twelve—the difference arising from the eccentricity of the orbit.

From this light-curve Stebbins shows that the principal star has a smaller companion, of one-third its diameter, and only one-thirtieth as bright. When this passes in front of the primary it produces an annular eclipse, cutting off eleven per cent of the light. When the companion is hidden behind the larger star the loss is only three per cent of the total light. This is the first time that the faint companion in an eclipsing pair has been found to be both smaller and duller in surface brightness than its primary. There are probably plenty of such systems in space; but a moment's consideration shows that in such a case the loss of light during eclipses must be small regardless of which star it be that is eclipsed; so that it is not likely to be detected except when, as in this case, something else tells us what stars to observe.

Even in this case, the companion is far from being a "dark star." Stebbins shows that it is probable the brighter star is about six times the sun's diameter, and the fainter one twice as large as the sun. The larger body is about one twenty-fifth as dense as the sun, and the smaller one seven times denser. We can only guess roughly the distance of the star from its proper motion, but this indicates a value of some 500 light-years. This would make the larger star about 300 times as bright as the sun. The "dark" companion would then be ten times brighter than the sun—and larger and hotter to boot—so that if the sun were its satellite, it would in turn be in danger of being called a "dark body."

The Heavens

Turning to our star map, we find the familiar constellations in their usual winter places—Orion on the meridian, Canis Major below, Canis Minor high in the southeast, Auriga, Taurus and Gemini grouped around the zenith, Hydra and Leo in the east, Ursa Major in the northeast, Ursa Minor and Draco in the north, Cassiopeia, Perseus and Andromeda in the northwest, and Cetus and Eridanus in the southwest.

The Planets

Mercury is an evening star, but is not well visible until the latter part of the month. At elongation, on the 29th, he is 18 degrees from the sun, and sets at 6.40 P. M. He is then in Aquarius, far from any bright stars, and being himself brighter than Capella, should be conspicuous.

Venus is a morning star, but is getting very near the sun so that she is practically invisible. Mars, on the contrary, is coming out toward quadrature and rises a little before 2 A. M. in the middle of the month.

Jupiter is in western quadrature on the 8th, and rises just after midnight, while Saturn, ten degrees to the westward, comes up some forty minutes earlier. Uranus is an evening star, too near the sun to be observable, while Neptune, in Cancer, is approaching opposition, and crosses the meridian at 1.30 A. M. in the middle of the month.

The moon is in the first quarter at 5 A. M. on the 6th, full at 10 A. M. on the 13th, in her last quarter at 1 A. M. on the 20th, and new at 7 P. M. on the 27th. She is nearest the earth on the 14th, and furthest away on the second and again on the 30th. During the month she passes by Uranus on the 3rd, Neptune on the 14th, Saturn on the 18th, Jupiter on the 19th, Mars early on the morning of the 21st, Venus on the 27th, Mercury on the 29th, and Uranus again on the 30th. The conjunctions with Jupiter and Mars are close, and should be worth looking at if one wakes early enough.

Princeton University Observatory.
November 4th, 1921.

The Mechanism of the Psychic

Indications of an Unformulated Force, and What We May Hope to Make of Them

By Hereward Carrington, Ph.D.

THE past century has been eminently scientific. In physics, chemistry, biology, astronomy—the physical sciences generally—vast progress has been made. But the further science progresses, the nearer do its conclusions tally with those for long taught by the so-called occult. And whereas science has done much to discover the grosser energies of the body, it has done very little toward discovering its finer and more subtle forces—those with which we apparently deal in psychic investigations, and upon the operation of which psychic phenomena depend. Here, I believe, is the field of the future.

Take, for example, the recent discovery, by Dr. Charles Russ, of the energy which is said to radiate from the human eye. A delicate solenoid of mica, covered with strips of aluminium, is suspended in a glass vessel, to the outside of which are affixed metal plates, electrically charged. When the gaze is focussed intently upon one end of the cylinder, it moves away from the eye; when the gaze is directed toward the other end, it moves toward the eye; and when the center of the cylinder is gazed at, it remains stationary. All normal causes seem to have been carefully eliminated, and, so far as I know, these results have never been explained.

Here we have an example of what I mean by the subtle energies of the body. This experiment is one of the first of this nature more or less admitted by orthodox scientists, and, if accepted, will constitute an opening wedge for the admission of further phenomena of the kind. All of which recalls the famous remark of Professor William James, that "whenever the mystics and the scientists have had a dispute as to certain phenomena, the mystics have nearly always been right as to the *facts themselves*, and the scientists have usually been right as to their *interpretation*." But interpretation is a secondary matter. Let us establish the facts first of all, and their interpretation will follow in due course.

This question of a vital energy of some sort, radiating from the human body, throws an interesting light upon other problems. For, if such an externalization takes place, it is possible that inanimate matter may be enabled, in some way, to receive and to store up this energy. Dr. Hodgson, through his experiments with Mrs. Piper, became convinced that objects handled by the medium did in fact stimulate phenomena, and insure, at times, a new flood of supernormal information. Whatever the explanation may be, the facts are undoubted, as I also observed in my own sittings with Mrs. Piper.

In haunted houses, again, a "psychic atmosphere" seems to be present; and we know that, in mediumistic séances, a definite "charging-up" process seems to take place within the cabinet, and from this cabinet radiate the phenomena. Other things being equal, a small room or a small cabinet is better than a larger one, which is what we should expect if an energy were being stored up for future use.

Take again the question of the human aura. We can artificially create an electric aura around living bodies by means of high-frequency currents; but this is quite a different thing from the natural aura, said to exist, and observed by Kilner and others by means of chemical screens. Kilner himself believes that this is an ultra-violet phenomenon, and, in his latest book, has published a number of interesting experiments as to the effects upon the aura of electricity, magnetism, various chemicals, etc. Here again is a whole field for study and research, relating to the subtle energies of the body, upon which, however, much light will be thrown by proof of the bodily radiations, or exteriorized energy, before referred to.

And here, of course, we are reminded of the phenomena of materialization—that incredible phenomenon, which has nevertheless been so well attested in the case of Eusapia Palladino, and other mediums in the past, and in the presence of Eva C. today. These phenomena, whatever their ultimate explanation may prove to be, certainly depend upon the emergence of a form of vital energy from the body of the medium. Into explanations I do not propose to enter. I wish only to emphasize that all these phenomena, and their subsequent interpretations, depend upon the central fact of the externalization, beyond the periphery of the body, of some form of vital energy.

All this has been pointed out in the past by competent investigators. Now, however, I wish to lay out one or two theoretical speculations which are, I believe, more or less novel in character. The first point is the apparent connection between the normal, physical energies of the body (and particularly the sexual energies) and certain psychic manifestations.

Mr. Podmore, in his analysis of a number of "poltergeist" cases, pointed out that the great majority of them occur in the presence of a young boy or girl between twelve and sixteen years of age. He endeavored to prove that trickery would account for the majority of these cases, if not for all of them, and assumed that the spirit of mischief, often present in children at that age, inspired them to produce the manifestations. Undoubtedly this was the motive in certain cases. But, in view of newer cases, quite unexplained, and of psychopathological researches into mediumship and hysteria, it now seems certain that many cases of this character are genuine, and that supernormal phenomena *do* occur in the presence of certain, peculiarly endowed individuals.

These "poltergeist" phenomena are usually spontaneous in character. They even continue to occur in spite of the opposition of the subject, as in the case of Angelique Cottin, about the middle of the last century. An energy seems to be radiated from the body, in such cases, which induces these phenomena; and it will be observed that this takes place at about the age of puberty, when the sexual energies are blossoming into maturity within the body. It would almost seem as though these energies, instead of taking their normal course, were somehow turned into another channel, and externalized beyond the limits of the body.

There may, therefore, be a definite connection between sex and psychic phenomena; and this seems to be borne out by several analogies. Recent physiological researches as to the activities of the ductless glands, and particularly the sex glands, have shown the enormous influence of these glands upon the physical and even upon the psychic life. The observations made in the cases of Kathleen Goligher and Eva C. show that the "plasma" which is materialized frequently issues from the genitals. The clinical observations of Lombroso, Morselli and others upon Eusapia Palladino brought to light many recognized sexual stigmata. And all ecstatic religious rites show the connection between sexual energies and the ecstatic states, just as we find instances of "sublimation" in modern Freudian psychoanalysis.

And speaking of Freud—it has often struck me as remarkable that more experiments have not been tried in crystal gazing, automatic writing, etc., with physical mediums, with a view to ascertaining possible subconscious associations. A detailed psychological study of the patient's utterances in *delirium* has never been undertaken; and assuredly the psychology of *insanity* is yet in its infancy! Nevertheless the study of all these conditions is of the utmost importance, since they throw light upon the psychology of mediumship; and, assuming for the moment the spiritistic hypothesis to be true, upon the mental state of the communicator while sending messages through the medium.

It is possible, however, that we shall yet have to take a further step before we shall be in a position to understand all this fully. I have, throughout, been speaking of the subconscious mind. Is it not possible that, in addition to this, and the conscious mind, there may also be a *superconscious;* that it is this mind which is active in certain ecstatic and trance states; that it is through this mind that all supernormal phenomena operate? It is possible that telepathy and other supernormal phenomena take place through this realm; that there is a "mentiferous ether," as some writers have suggested, which carries telepathic waves. The discovery of this ether, or of the actual mechanism of thought-transference, would assuredly be a profoundly important one for psychical science!

Just here, perhaps, I may be permitted to offer a suggestion, based on analogy with the "carrier waves" sometimes employed in radio. It would certainly be interesting to try experiments in telepathy in, say, a high-tension electric field, through which electric waves of definite frequency are passing which might act as carrier waves. Under these circumstances it is conceivable that telepathic waves, if such exist, might be reinforced and rendered perceptible by some delicate recording apparatus. At least the experiment should be tried. Experiments should also be tried, it seems to me, while both sender and percipient were breathing in unison, or when certain chords were struck on the piano. Though all these tests might lead to no definite results, it would be at any rate interesting to try them; and so far as I know they have never been tried.

This idea—that telepathy must be in some sense dynamic in character—throws light upon a variety of problems: thought photography, telekinesis, the operation of certain instruments. If mind is thus active, and the vital energies are also capable of acting beyond the periphery of the body, we may derive from these facts the general conclusion that, in all its activities, *life is dynamic.*

I would here emphasize one important point which has been to some extent overlooked: the rapid and remarkable growth of instrumental tests. How simple and relatively primitive were the tests undertaken by Professor Hare and Sir William Crookes compared with the complicated and beautiful apparatus which has been devised and is employed in psychic investigation today! We can trace the gradual evolution of such laboratory methods, from the first tests made by Hare and Crookes, to those employed by Bottazzi, Lombroso, Imoda, and others with Eusapia Palladino; to those conducted by the General Psychological Institute, of Paris, with the same medium; to Dr. Coover's kymograph tests with "Mrs. Key;" to Dr. Crawford's ingenious tests with Miss Goligher; to Dr. von Schrenck-Notzing's photographic and microscopic tests with Eva C.; to the beautiful apparatus perfected by Dr. Grunewald. This shows an evolution of scientific laboratory methods comparable to that of any other science.

We in America are endeavoring to push still further this line of investigation. "The American Psychical Institute and Laboratory" has been founded in New York, for the purpose of investigating certain branches of psychic phenomena, by instrumental means in a properly equipped laboratory. We have already secured the names of a number of eminent men for our Council, and it is my hope that we may be enabled to secure many more, and to justify their support and adhesion by our work, which we shall endeavor to make sound and scientific.

We began, very naturally, by acquiring or building a

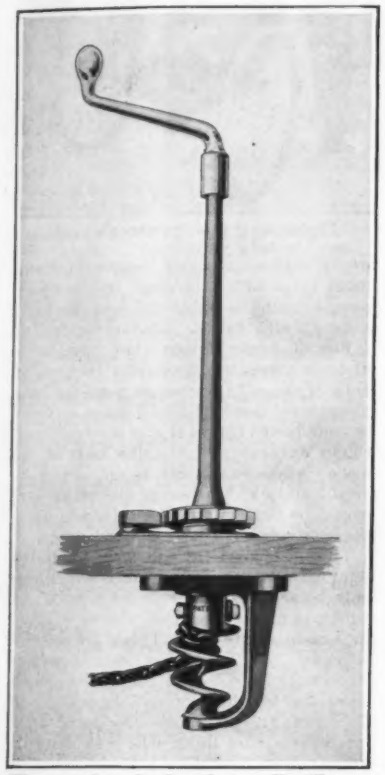
(*Continued on page 80*)

EVERY age sees a new science—a whole body of new phenomena and the principles that govern them, developed where we had not even been conscious of a void in our knowledge. Once it was electricity; again it was psychology. Now it is the field to which the name of psychic has been given. We have no reference to the question of personal survival or that of communication with those alleged to have survived. But there is a growing fund of authenticated phenomena which can be explained by no natural law yet formulated. When all cases of fraud and misinterpretation are ruled out, there remains a residuum of manifestations which can best be taken to indicate the existence of an unidentified force. We may hope that the science of tomorrow will tell us what this force is, and give us control over it.

Substantially thus we spoke in our 75th anniversary number fifteen months ago. We have since been searching for some authority who could formulate the problem, describe what has already been accomplished, and outline the possibilities of the future in a sane manner. In Dr. Carrington we have such a man—one who for years has been in close touch with the respectable side of the psychic world, and who is sufficiently acquainted with the other side to know where to steer to avoid it. Naturally in any subject that consists so largely of forecast and speculation he must speak for himself and not for the SCIENTIFIC AMERICAN. *It is, however, a pleasure to put his remarks before our readers. He plans to say more in a future issue.*—THE EDITOR.

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts



The gearless brake that pulls like a geared one

Increased Hand-Brake Efficiency

THE simple staff hand-brake in use on passenger and freight trains is largely a survival from the day of lighter loads and lower speeds. Under present conditions it is often entirely inadequate to meet the loads put upon it. While geared brakes meet the need for greater power and a number of these are in use, objections based upon initial cost, weight, size, or failure to release satisfactorily have prevented their general installation. An interesting design of brake staff has just been put forward, giving all the advantages of the geared brake with none of its disadvantages, according to the manufacturer.

For any given pull on the brake handle of a staff brake the tension on the chain varies inversely as the distance from the center of the chain, in winding, to the center of the staff. The brake which we illustrate has a winding channel for the chain to run in, and the shank around which this channel passes tapers toward the bottom and at the same time runs out of the true center-line of the upper portion. The result is to give less tension and rapid take-up of the slack in the chain at the start of the braking operation, with slower take-up and greater braking tension toward the end, where it is useful. The ultimate result is that, operating with the ease of a gearless brake, the efficiency is that of a geared brake with ratio of three to one.

A Grease-Cup Wrench

SCREWING down grease-cups by hand is a dirty job, as every driver knows. And there is little satisfaction in trying to substitute for the dirty finger any wrench or pliers of conventional design. It always turns out that the instrument that will grip the circular rim of the grease-cup without slipping has its handle attached to the business end in such a way that the leverage is not at the proper angle for this use. But now we are offered a modification of the socket wrench, designed especially for the grease-cup job; and the picture shown herewith makes it plain that at last we may hope to keep our cars greased and our fingers clean at the same time.

Making an Addresser of the Typewriter

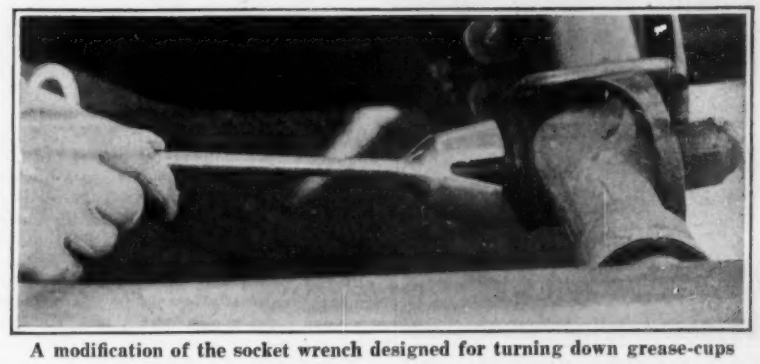
ADDRESSING envelopes on the typewriter is something that is always avoided when there is a large number of envelopes to deal with and any possible way of addressing them by other means. It is not that the actual work of typing on the envelope is slow or unsatisfactory in its results; but the placing of the envelope in the machine and its removal are operations that take time. We can afford to put a sheet in and take it out again in connection with the writing of a letter of reasonable length; but when it comes to the mere typing of name and address, the non-productive end of the job assumes too large proportions in comparison with the time which the operator is able to devote to actual typing.

Large batches of envelopes, however, can not always be addressed from a mailing list prepared in advance, and hence the various addressing machines which one would prefer to the typewriter are not always susceptible of use. It is with this situation in mind that a Cleveland manufacturer has put out a rapid-fire feeder that handles the envelopes for the typewriter, and reduces the operator's efforts almost entirely to the manipulation of the keyboard. The appearance of the new device, which can easily be attached to any standard model typewriter, is shown by our photograph. In operation, a single motion of the operating lever puts into effect the following operations:

The envelope is brought down and placed in the carriage in the exact position for the first stroke of the keys. The carriage is moved to proper position for this stroke. The list-holder moves the list of names upward, keeping the next name to be addressed constantly before the operator. A counting device attached to the feeder registers, so that at all times the exact number of envelopes addressed is known. The previously addressed envelope is ejected as the one to be addressed is brought into position—so that the carriage is never empty.

The apparatus is fitted for use both with a continuous list and with cards. The list-holder operates entirely automatically, as indicated above. With the card-holder, the cards must be removed from front to rear by hand as they are addressed; this operation consumes no more time than is necessary for the shifting of envelopes, hence results in no loss of time at all, and leaves the card file, at the end, in the same order as at the beginning. The card-holder is easily adjusted to fit any standard size of card, and has a capacity of about 125 cards, after which it must be replenished from the file. The counter can be permitted to run to the end of the job, or can be set back to 1 at any moment.

The quick and easy attachment that converts the ordinary typewriter into a speedy addressing machine



A modification of the socket wrench designed for turning down grease-cups

The "Haltstellenanzeiger"

MOST of us have had the distressing experience of standing on a corner of the main street of an unfamiliar town, where apparently all the car-lines in the county ran, and of waiting and waiting for the desired car, eventually to learn that it runs through another street three blocks to the north. Or perhaps our troubles arose from a staggered-stop system, where some lines stop at every corner, others at alternate corners only, and the interurban expresses every half-mile or so. In any event, we shall recognize the instant and automatic solution in the trolley-station pole illustrated herewith, which has been installed at Berlin's busy corners. All lines in the city are designated by numbers, much like the several lines of the Fifth Avenue 'Bus Company in New York. These numbers do not replace altogether a fuller statement of destination, etc., but they do make possible the identification of a car from a much greater distance than would be the case in their absence. And with the numbers on the cars, and a complete list on the pole of all lines that stop there, the stranger in town knows instantly whether he can get his car at this point or whether he must inquire. The stopping-place indicator, to translate the name of this device, could find a place in many American cities. But if it were to be given this place, we are sure that the spaces left for advertising placards would not show so many vacancies as the apparently more conservative Berlin merchants have allowed to remain unfilled.

The trolley pole that lists all cars stopping at this corner

Not a new stove: merely the latest deep-sea-diving outfit

The Washfountain

EVEN the fountain, that classic symbol of all that is ornamental, has now been converted to the uses of utility. An American manufacturer has recently put on the market a device which he calls a "washfountain." It may be used wherever large wash-rooms are necessary; in factories, schools, public buildings, hotels and railway stations—in fact, every public or industrial lavatory.

The saving in space is considerable as compared with the old-fashioned wash bowls. It has been shown that bowls for 24 people require a minimum of 91 square feet floor space, while the washfountain accommodates an equal number in comfort using only 64 feet. This economy naturally increases with each succeeding installation.

The fountains are manufactured in two sizes—a 54-inch basin to accommodate 12 people, or a smaller, 32-inch, where six people may wash at one time. Due to the circular construction of the fountain there is plenty of "elbow room" for the comfort of the users.

Considerable economy is effected in the amount of water consumed. The washfountain built to accommodate 12 people, for instance, uses no more water than the amount piped for one wash bowl. This is accomplished by converting the flow into a fine stream—just as effective. Hot water costs are also reduced, since the water may be heated at any desired temperature, evenly.

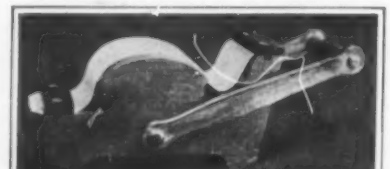
Soap is supplied to the washfountain by a device which is part of its design. Either liquid containers of sturdy glass and nickel or receivers to hold cake soap may be specified. The flow of water is controlled either by a hand-valve or a foot-lever, as desired.

Drinking-fountain practice extended to the wash-room

Submarine Armor

THE effort to increase the vertical radius of action of the diver is one which we shall always have with us—the more so in view of the tantalizing fact that most of the sunken treasure of the late war is at a depth only moderately below the present limit of operations. For a good many years there has been no material technical advance in deep-sea-diving outfits. Each designer has, to be sure, added or tried to add some further margin of safety, but all attacks upon the problem have followed substantially the same line. If we can but make a suit that will stand up under the pressure and keep the water out of its seams, it is obvious that we can go to any depth for which these requirements are still met. If in the bargain we can make a suit with joints that can be operated at such depth by the muscular power of a husky man, we shall be able to work there as well as go there.

The deep-sea-diving outfit illustrated herewith is not presented because of any claimed departure in fundamentals from its predecessors, but purely because of its fearful and wonderful appearance. Perhaps the nearest thing to actual novelty which it shows is the frank admission that direct work with the hands is not to be attempted, and its consequent provision of artificial hands, not sensitive to pressure. The ball-and-socket joints look, too, as though they might permit considerable motion without change of volume of water displaced, thereby obviating one of the great difficulties of deep-sea work—the fact that as soon as the diver once assumed the position in which his displacement is a minimum, further movement must be against the entire pressure developed by the water at the depth in question. More than one diver has found himself "frozen" in this position of minimum volume and unable to move out of it.



French machine for rolling cigarettes with one hand

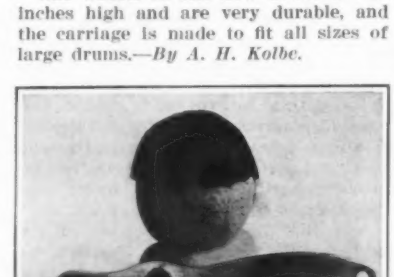
A Machine for "Rolling Your Own"

AMONG recent inventions few are more clever than the cigarette-rolling machine put out by M. de Louvencourt, of Paris. Referring to the illustration, the white band that extends clear across the apparatus from end to end is a strip of draftsman's tracing paper. This furnishes the background against which the rolling operation is carried on. A pinch of tobacco is laid upon this ground in the hollow at the right, the tobacco accommodating itself to the curve. French tobacco, being stringy instead of finely cut, works best in this device. The handle is then swung up and over the top of the machine toward the left. The loose end of the tracing paper is picked up and bent over gradually, and at the appropriate moment a piece of cigarette paper is introduced. As the cigarette paper and the tobacco are rolled along by the handle, the former is looped double, with its end at just the psychological spot, so that continuation of the motion starts it rolling up on itself—with the tobacco inside all the time, of course. The completely rolled smoke is delivered at the left end of the "machine," and has but to be extricated from its tracing-paper entanglement, licked and sealed. The machine works admirably with the long, stringy tobacco prevalent in France. It is less efficient with our finer plug cut, but for the man who has but one hand and who has never been able to learn the trick of rolling his own with that hand it should still be a very happy solution of the problem.

A Carriage for the Perspiring Drummer

A BASS-DRUM carriage which will do away in parades and orchestras with the sight of the perspiring drummer with an enormous drum strapped around his neck, has now been perfected. On this new device a drummer can now easily rest his large, bulky and heavy bass drum, and roll it along any distance without being interfered with in his playing.

The wheels of this new device are 28 inches high and are very durable, and the carriage is made to fit all sizes of large drums.—*By A. H. Kolbe.*



The non-squirting orange peeler

Juiceless Orange Peeler

TO peel an orange so that the juice escapes the fingers is a trick that few lovers of the fruit can accomplish. Those of us who have eaten oranges in their native states are told that the most enjoyment and real flavor comes when we eat the orange by quarters.

A juiceless peel for oranges is now assured by the use of a new orange peeler. A groove is first cut around the center. After this is removed, the spoon end of the device is used to turn down the skin. It does so quickly and without letting any juice escape on the fingers.—*By M. M. Hunting.*

Artificial Daylight for the Movies

THE thousands of movie fans who marvel at the wonderful photography as hundreds of feet of film are displayed on the screen and who perhaps know from their personal experiences with a camera that sunlight is so highly essential to good pictures, will undoubtedly marvel still more when told that artificial illumination is used almost entirely in the making of films.

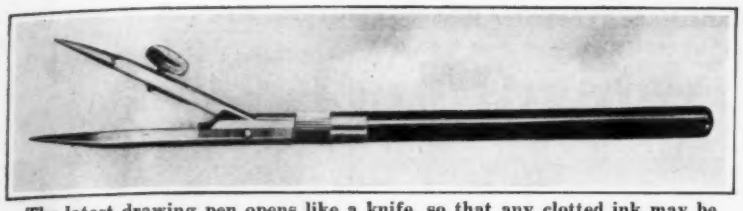
For years motion pictures were produced almost entirely in southern California because of the quality and duration of sunlight available. Although sunlight is the brightest possible light, it does not meet present-day requirements of the movie concerns. Within recent years methods of artificial illumination have been so greatly improved and developed that sunlight is being superseded by electric lighting. This form of illumination can be controlled and directed at will, a feature of no small importance.

With the sunlight no special effects, so essential to the motion picture in its present advanced stage of artistic development, could be obtained. Even on a clear day light values do not remain throughout the day at the same intensity. At noon perhaps the light is very bright, but as the day begins to wane about three or four o'clock in the afternoon, the photographic value of the light is very much lower. In the making of a film it may happen that part of a scene is filmed at noon, and because of some changes in scenes or need for new characters, there will be a delay of three or four hours before it can be completed. Under natural light the first part of the scene when screened would be very bright and clear, whereas the other part would be darker and less distinct, causing confusing effect to the spectator.

Lightening the drummer's load

Thus the need for an even, unaltered light at all times of the day which can only be supplied by artificial means, and which is now being used almost entirely in American studios. There are several schemes for producing this constant illumination. One of the latest comes from the big factory and laboratory in Schenectady, and uses the new high-intensity studio light, which in external appearances resembles a searchlight. It can be used as a spot or flood light, much the same as the searchlight where the light rays are focused and projected in a small beam, or as a prime flat light to illuminate the entire setting or scene. This can be done by removing the glass mirror at the back, which focuses the light rays, and thus allowing a general spread of the light from that end of the projector. The light itself has a 24-inch mirror, its carbons are fed together electrically requiring practically no atten-

High-intensity motion-picture studio light that is fast replacing daylight in this industry



The latest drawing pen opens like a knife, so that any clotted ink may be easily removed

tion, and its entire operation is of the most simple nature. It is mounted on a base with rubber-tired wheels of a large diameter, making it easy to move about, and can be raised to an elevation of about 10 feet, where an overhead spotlight is desired. The entire device weighs less than 500 pounds.

This light, one of the most powerful adapted to the studio, is particularly useful where moonlight or sunlight coming through a window or the illumination of large settings is desired It is also valuable for back-lighting. By focusing a spotlight on the back of the heads of the principals the images are caused to stand out from the background and the figures are more pronounced and thus a better depth is obtained. If this were not done the figures would go dead against the background, no matter how far they stood in the perspective. They are also used a great deal to counteract shadows caused by other lighting apparatus.

Even out of doors in the daylight there is use for artificial illumination. There are scenes, just as in ordinary photography, that are too dark even at midday to be taken without extra light. Then, too, there are times in the bright sunlight where artificial light is needed to counteract shadows caused by the sun or to light up faces of persons when their backs may be to the source of natural light. To meet such situations a portable power plant has been perfected—an electric generating outfit mounted in a motor truck. A gas engine drives an electric generator, which supplies sufficient power to operate the powerful lights, the same as used in the studio.

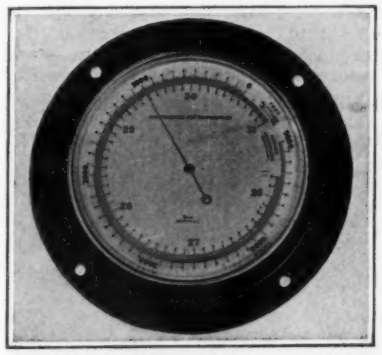
Testing Cylinder Variation

AN instrument that indicates easily and accurately the size and concentricity of a cylinder throughout its entire length is being manufactured by a Rhode Island firm. In this device gage feelers project from the casing. These feelers are actuated by means of a cone cam, inside the casing, which is directly connected by a steel rod running through the tube to a rack and spur movement that operates the dial hand. A button projecting through the knurled sleeve is attached to the steel rod. By pushing this button down the cone cam is likewise lowered and the feelers are permitted to recede sufficiently to be inserted in the cylinder. Pressure on the button is withdrawn when the feelers are inside the bore, and they are automatically released against the cylinder walls.

Provision has been made for building up one of the three feelers so that with a set of extensions measurements can be taken of any diameter between 2½ inches and 6½ inches. Nipples are made in different sizes to cover any fractional part of an inch. The nipples fit interchangeably into the extension rods, which vary in length by 1-inch steps and supported by thread bushings. The gage dial is graduated by .001 inch with sufficient space between calibrations to allow variations of .0005 inch to be easily read. The dial is always in plain sight and can be set to any position with reference to the hand by turning a knurled bezel. A master is used, at times, to furnish a means for setting the gage accurately to a standard diameter.

In use, the instrument is rocked from side to side and the smallest plus or the largest minus reading of the gage indicates the actual error at the point of application.

A model is also constructed for measuring cylinders of a standard diameter.



An altitude indicator that may clear the carbureter of unjust suspicion

It differs from the other model in having three solid feelers of equal length centrally located. A centralizer, to hold the instrument in the center of the cylinder, has a three-point bearing. To compensate for slight variations from the standard, the bearing surface of one of the three centralizer lugs is cut away and a flat copper spring is attached to it. The collar or depth stop is held by a set-screw and can be placed on the body to conform with the depth of the cylinder to be measured and thus prevents the feelers from being thrust beyond the bottom of the hole.—*By Allen P. Child.*

The Art of Using a Drafting Pen

ANYONE who has an inventive turn of mind has occasion now and then to make a drawing of some invention or device which he may afterward wish to have constructed, and yet the beginner in such efforts seems to experience great difficulty in the use of the drawing pen. Even persons who have practiced for a considerable time are often unable to make lines of uniform thickness and appearance.

Troubles of such a nature usually result from imperfect flow of the ink. As the pen points are but a little way apart the ink will cease to flow regularly as soon as it hardens or thickens to the least extent. Drawing ink is made to dry quickly to prevent blotting and smearing during the frequent shifting of the triangles or straight-edge. That is the reason that wiping the pen and cleaning it thoroughly is necessary at frequent intervals.

The beginner does not appreciate this necessity for keeping the pen points free from clotted ink, and consequently he wonders at his frequent failures and becomes discouraged with his work. To make the cleansing process easier, some of the latest types of ruling pens open and shut like a knife, so that a cloth can be inserted between the points without any difficulty. The type shown in the figure is of this kind, and it is provided also with marks on the set-screw for adjusting accurately the distance apart of the points and regulating the thickness of the lines.—*By H. C. Ridgeley.*

For the Mountaineering Motorist

FOR the tourist or those who live in mountain country comes the automobile altimeter. It is a compact little instrument which sets into the dash of your car and tells you exactly what height you are above sea level. If your engine starts choking or sputtering, when your car is equipped with one of these altimeters, you can easily tell whether the carbureter or the altitude is to blame.—*By F. G. Jopp.*

The New Rumpler Car

THE most radical departure from existing methods of motor-car design shown at the Berlin exhibition no doubt is to be found in the Rumpler *"Drop" Car*, a striking adaptation of the experience gained in the construction of aircraft. The three innovations embodied are: First, the body as well as the chassis is drop-shaped, that is, has been given the shape corresponding to a minimum air resistance, as in the case of a falling drop. Secondly, the motor is arranged in the rear part of the car and is, with the gear, clutch and rear axle, combined

Clean sleeves as well as clean hands follow the use of this glove

in a compact system described as "motor-gear-axle." The third, and perhaps most important, feature is the use of a double-sectioned rear wheel axle, oscillating round the center of the car and thus reducing to an unprecedented minimum the weight of masses not hung up in springs.

The cruising garage—a friend in need on California's main highway

"Here Comes Help!"

WHEN you're miles from a garage and your car refuses to budge another inch, and maybe your gasoline is all gone, or a broken axle or a parted universal joint or a smashed gear-box or a differential that won't differentiate seems to have condemned you to an all-night stand, wouldn't you smile if you saw a sign loom up in the distance, "Here Comes Help"?

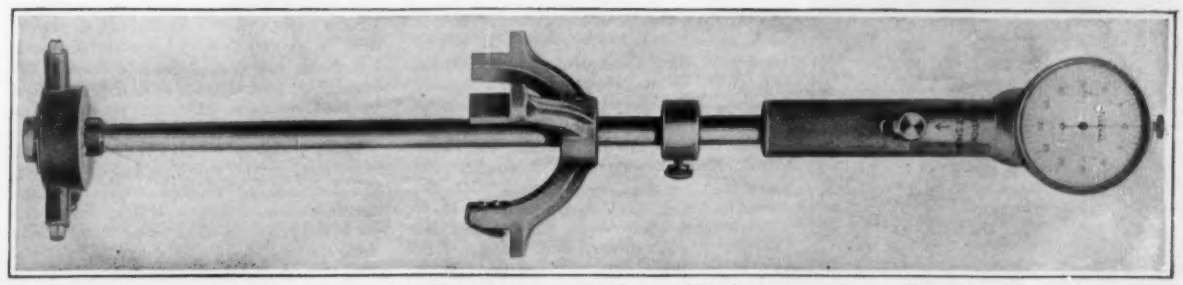
Patroling the highway, El Camino Real, which extends from San Francisco to Los Angeles, is a completely fitted-up wrecking car with this comforting sign on it, and its owner is kept pretty busy on Sundays and holidays, as the traffic on this highway is very heavy.

Metallurgical Examination of a Broken Crank-shaft

A BROKEN crank-shaft from a 10-ton ammonia refrigeration machine was submitted to the Bureau of Standards for examination by one of the other Government departments. The material proved porous and showed evidence of not having received sufficient reduction in forging. The break which occurred was in the nature of a fatigue failure and had its origin in the angle between one of the throws and the bearing. A defect at this point had been filled in previously with arc-fused metal. Such a procedure would not necessarily lead to failure had the defect been located elsewhere, but at the point in question the stresses are much higher than at other points on the shaft, and the break once started would be propagated rapidly owing to the unsoundness of the steel.

Long Gloves Save Sleeves

A LONG-WRISTED glove for the use of automobile owners when making minor repairs about a car is one of the new accessories seen in automobile row shops. This particular glove is made of washable material, and has a strap and buckle at the top which aid in keeping the long wrist high on the arm. Protection to sleeves is provided with a consequent reduction in laundry and cleaner's bills. The long-wristed glove is not only for the use of car owners, but can be used to advantage about the house, as for use in stoking the furnace.



For obvious reasons we show lying on its side this instrument for rapidly measuring the small variations found in automobile cylinders. The dial is really the top of the apparatus

Not a phonograph, a heater for the parlor

Parlor Furnace That Looks Like Phonograph

A CLEVER designer has developed a heater which many people who object to a stove in the parlor will welcome. It has all of the appearance of a cabinet phonograph, yet it works as a pipeless furnace. It is, however, made of steel plates, but they are finished to look like mahogany, grained like rare old wood, polished to the fine luster of expensive furniture.

Starting with the name which ends with a "rola," the resemblance to a phonograph is carried out in the design of the front, the sides, top and supporting legs. Ornamentation such as one finds on a wooden cabinet is used.

This affair is in reality a pipeless furnace which will heat from three to six connecting rooms. It will burn any kind of coal and holds fire for fifty hours.

It is claimed for this heater that housewives will find it more easily kept clean, as the polished mahogany finish requires but to be rubbed with a cloth just as furniture is handled.—By *Charles A. Goddard.*

High Temperature and Concrete

FIRES where temperatures are reached sufficiently high to cause the fusion of metal window frames, brick and concrete are rare. Therefore the high temperature fire which took place last year in the chemical works of the Barrett Manufacturing Company, near Philadelphia, is of special interest.

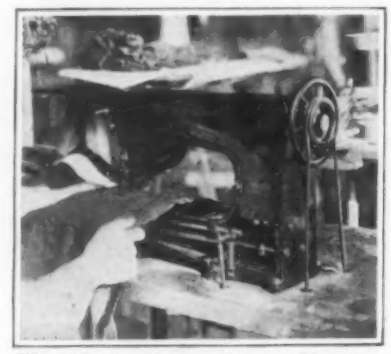
The building destroyed was a two-story structure used for the cooling of naphthalene, which was stored in flat tanks, some resting directly on the beams of the upper story and others at intermediate levels on both stories. The whole structure was of reinforced concrete with the exception of two unprotected steel roofs, and it should be noted that the upper floor was constituted by the beams and the naphthalene tanks, no flooring, in the ordinary acceptation of the term, having been provided. The fire started in one of two naphthalene tanks outside the building, and the flames rapidly spread to the interior tanks, the building having been gutted within 45 minutes after the initial outbreak. It appears that the steel roofing collapsed almost immediately after the fire started, bringing down the second floor. Naturally, the heat was most intense nearest the exterior tank, and on the side facing the latter some of the concrete was fused, wired glass was melted, and steel window mullions melted and ran down the frames in places.

From a consideration of all the data available the following conclusions have been drawn: the spalling of the concrete was largely due to the use of coarse aggregate containing a large percentage of quartz; the adoption of square columns accentuated the amount of spalling; the structural part of concrete should have a protective coating, the thickness adopted being governed by the temperature to which the construction may be subjected; the sprinkler installation was rendered inefficient by breakage of the electrical circuit operating the pumps. Finally, the engineers of the owners are said to be of opinion that there is no material more suitable than reinforced concrete for use under conditions such as those prevailing in the building destroyed, and that this material should be employed in the work of reconstruction.

The auxiliary lamps (see arrow) follow the wheels on every turn

Sewing Machine for Furriers

A PECULIARLY sensitive machine for sewing furs is making the life of the furrier easier. As it is highly undesirable that stitches should anywhere appear on the outer or fur side of a garment, a machine of unusual construction is necessary. The needle does not sew straight down and up in the customary way. Instead there is a sidewise motion practically parallel with the surface of the material.—By *William Walsh.*



The side-stepping sewing machine for furriers

Lamps That Turn with the Wheels

AMONG the things that every driver knows about his headlights is the fact that they don't always shine where he wants them. Particularly in making a sharp turn the wheels often get ahead of the lights, and one is in doubt as to just where the car is headed. The auxiliary lights illustrated herewith are mounted so that they swing with the wheels, and are therefore bound to throw their beams as far around the corner as convenience could possibly require. Incidentally they are right down on the road, where the light is wanted.—*By F. G. Jopp.*

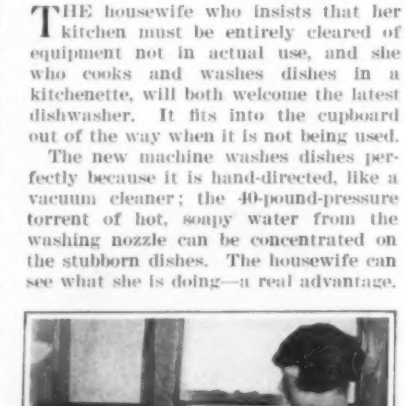
Home-Made Typewriter Ribbons

THIS mechanism takes in a piece of raw white tape and turns it out a finished typewriter ribbon ready to be inserted in a machine. The tape unrolls from the flat holder or cylinder at the right around a series of smaller cylinders or holders, as the crank is turned by hand. At the bottom of the middle center is a well which inks the tape in the process.

The Torrent Dishwasher

THE housewife who insists that her kitchen must be entirely cleared of equipment not in actual use, and she who cooks and washes dishes in a kitchenette, will both welcome the latest dishwasher. It fits into the cupboard out of the way when it is not being used.

The new machine washes dishes perfectly because it is hand-directed, like a vacuum cleaner; the 40-pound-pressure torrent of hot, soapy water from the washing nozzle can be concentrated on the stubborn dishes. The housewife can see what she is doing—a real advantage.



Forty pounds pressure behind this dishwasher

This washing nozzle, which attaches to the hot water faucet, furnishes by means of a small thumb lever either soapy or clear water.

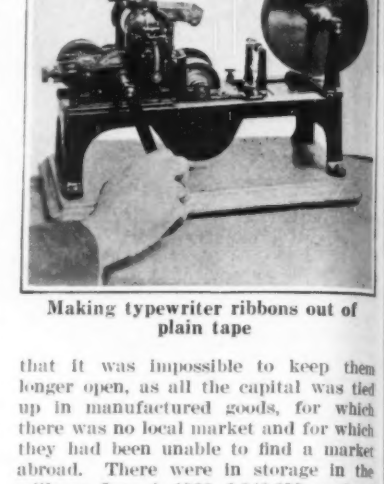
Specially designed wire baskets hold the dishes firmly in place. A splash-guard which pulls up telescope style during washing keeps the splash inside; it is because this splash-guard drops down out of the way that this washer goes into a cupboard.

This machine has all the advantages over the old dishpan that a dishwasher is expected to have—it does the job more quickly (5 or 6 minutes); it washes dishes cleaner and in a more sanitary way (by running water); it keeps milady's hands out of dishwater and so does its share toward keeping them soft and white. And very important, she can see what she is doing and know the dishes are clean.

The Esthonian Cotton-Goods Industry

AS a result of the unsettled conditions in soviet Russia and the consequent loss of the market for the semifinished (unbleached) cloth manufactured there, the Esthonian cotton industry is passing through a crisis which has resulted in the practical closing down of the Kränholm cotton mill at Narva, Esthonia, one of the largest in Europe and the largest in the former Russian Empire, which before the war employed over 10,000 hands and manufactured yearly over 70,000,000 yards of semifinished cotton cloth, which was sent to Russia for bleaching and dyeing and then utilized in that country. During the war the importation of raw materials was suspended, and the output of the mill was restricted to the stock on hand. During the German occupation some raw material was obtained, enabling the works to keep going to a limited extent. In 1920 the mill employed about 2000 hands, the output being 7,700,000 to 9,000,000 yards of cotton stuff.

The administration of the mills stated that it was impossible to keep them longer open, as all the capital was tied up in manufactured goods, for which there was no local market and for which they had been unable to find a market abroad. There were in storage in the mills on June 1, 1920, 3,240,259 yards of textiles. From June, 1920, to February, 1921, 6,521,011 yards were manufactured, while during the same period only 26 per cent of the whole production was sold. The Baltic Cotton Mills, Reval, are still working on government orders, but when these are finished the question of closing these mills will also have to be faced. In order to continue manufacturing the mills will have to obtain credits to purchase cotton from the United States, while they continue to hold the manufactured goods until conditions in Russia open up a market for them there or a market elsewhere is found.



Making typewriter ribbons out of plain tape

A Better Mop Wringer

NO longer is it necessary for a woman to wring the household mop with her hands. This spiral mop wringer is made from one long piece of heavy wire. In use it is placed over a bucket as shown, with one foot of the user on the extension resting on the floor. As the mop is pushed down into the spiral-shaped wringer, the user turns the mop slowly to the right. The wires coming in contact with the mop head act as threads and hold the mop securely, wringing all water out, as it is slowly pushed down into the tip of the spiral.—By *M. M. Hunting.*

Getting the mop dry

Our Readers' Point of View

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

Seaworthy Yachts

To the Editor of the SCIENTIFIC AMERICAN:

I have not seen the issue of the SCIENTIFIC AMERICAN in which the "Universal" Yacht Measurement Regulations are commented on. I presume, however, you are correctly reported as saying that the New York Yacht Club should hesitate to stick to a rule which produced a pair of boats which were afraid to face a summer breeze of more than very moderate weight.

I agree that it was somewhat humiliating to find it injudicious to race on the day referred to; but I can not help pointing out that the remedy does not lie in the one rule or the other. The "Universal" rule can not be said to have produced the two boats, because they were unlimited in design and size except in one measurement, namely, length on waterline. They were only measured for *time allowance* by the "Universal" rule. To give the rule a proper chance, they ought to have been built to a class under the rule. (Of course, the fact that time allowance was reckoned by measurement under the "Universal" rule could not but have an influence on the designs.) Had all the conditions remained the same, and the time allowance reckoned under the "International" rule, there is little reason to assume that any better sea boats would have been produced.

All I want to say is that I think the desired result could very simply be obtained. The stipulation in the deed of gift that a challenger has to sail across the ocean was made with excellent intention, namely, to ensure a seaworthy vessel—*the very thing you are after.* Of course, we all know how that intention has been frustrated. But by limiting the time taken to sail the course, say, to three hours, or even less, this would ensure the necessary strength in hull, spars, and gear, and a more moderate sail spread.

The control of scantlings of the hull without any similar control of spars, sails, and other gear is as if Lloyd's were to class the hull of a steamer without dealing with the machinery.

Glasgow, Scotland. J. R. BARNETT.

Industrial and Technical Photography

To the Editor of the SCIENTIFIC AMERICAN:

During the last few years photography has more and more developed to be an important factor in industry, commerce, and science, and a number of large concerns have established permanent photographic departments of their own as an aid to better efficiency in administration, engineering, research, buying, selling, advertising, education, cooperation, and for many special purposes peculiar to the individual needs of the concerns.

All have been striving for the same result—to make photography a help and not merely an added overhead expense. As industrial and technical photography not only have come to stay but will get a much larger application in the future than heretofore, it would seem wise if all organizations which use photography in one form or another could put their experiences together for the mutual benefit or all.

It is, therefore, the purpose of this letter to ask every one using photography in their plants or organizations, to assist the writer in making a survey of industrial and technical photography by sending him samples of different types of photographs used; a short statement of how and why photography is being used, as in field, office, plant or research; information as to how far an outside photographer is employed; or if the users have photographic departments of their own, together with a history of the development of the same. Methods of mounting, filing and reference are important; also statements of the cost and upkeep of the departments and the value and importance of them.

In case one has a photographic department of his own, would it be advisable to recruit his help from the photographic profession, or develop some of his men for this work? Should our technical schools develop men as photographical engineers to meet the growing demand for practical, industrial photographers?

The writer will compile all this data and information, and together with his experience of eight years in the development of industrial photography, make a complete history of the development and uses of the same, to be published in one of our leading technical magazines. The more each one contributes to an article of this kind, the more valuable it becomes.

Would a convention of the users of industrial and technical photography be of any value? If so, would you pledge your presence and support to a convention of this kind, and where would you suggest this to be held?

If enough interest and a large enough attendance for a conference of this kind could be secured, the plan would be to arrange a conference with an exhibition of all forms of technical and industrial photographs, and lectures on different photographic subjects in relation to industry, science, research and commerce.

JOHN H. GRAFF,
Industrial Photographer and Photomicroscopist, Brown Company,
Berlin, N. H.

The Deadly Exhaust in New Dress

To the Editor of the SCIENTIFIC AMERICAN:

The publicity bureau of the Department of Health seeks the aid of your publication and its readers relative to a rather unusual incident, and one which came very near being serious and causing loss of life.

The practice that brought this accident about apparently has been overlooked by the designers of a special line of motor vehicles, and if continued will no doubt lead to future serious consequences. The Department of Health of New York City is therefore considering regulation relative to this menace. The following case was reported on August 27, 1921, by the police of the 56th Precinct, New York City:

W. H., eighteen years old, residing in Trenton, N. J., was overcome by inhaling the fumes of the exhaust from the motor truck, while traveling on the rear of the same from New Haven to New York as a driver's helper to watch the load and prevent loss of goods while en route. The young man was removed to the Fordham Hospital immediately by ambulance. Recovered.

An industrial sanitary inspector of this department investigated the accident and reported that the motor truck had the engine on the forward part of the chassis and the exhaust was immediately in the rear of the flywheel. The motor truck body was an open one, carrying a load of boxes covered with a large canvas weather protector. The driver and his helper sat on the front seat of the truck and a second helper sat on the rear of the truck to watch while en route, and thus prevent loss of property. About halfway down he noticed that he felt sick, nauseated, clammy, and developed a headache. He thought it was incident to indigestion, and when nearing the city, still continued to feel ill, and fainted.

The inspector reports that it is his opinion as the truck was speeding along, the exhaust gases from the motor entered the vehicle by air suction and the constant inspiration of these poisons gassed the helper in the rear of the truck.

This is the first case of this character reported to the Division of Industrial Hygiene of the New York City Department of Health. The investigation is not completed, but the danger is so apparent that the matter is called to the attention of the scientific authorities in order that consideration will be given to the proper dispersion of the spent gases, as we have observed that a large number of trucks have their muffler very close to the engine in the forward one-third of the chassis, whereas other automobiles—touring cars and the closed type of automobile, sedan and limousine—have the muffler in the rear underneath the body, giving the gases an opportunity to escape to the rear of the machine and not be drawn up into the body of the passenger-carrying compartment.

As it is the practice of a large number of merchants to have helpers on the rear of their trucks to aid the drivers in delivering the goods, also to watch the loads while en route, we have here a serious menace unless these gases are properly dispersed, which can be done by an extension pipe carrying the muffler to the rear of the vehicle instead of discharging the gases, as at present, in the forward part of the frame.

This accident also calls attention to the fact that in physical examinations made of a number of chauffeurs they were found to be suffering generally from chronic carbon monoxide poisoning, as expressed by pallor, weakness, inertia, and a general physical breakdown. The attention of merchants doing large business and operating a number of trucks has been called to this matter with the request that engines on these trucks not be kept running while the rear helpers are unloading; also that gases be discharged in such manner as not to enter load if goods are to be shipped any distance, so the helper in the rear will not be gassed.

It is also feared that probably a number of these helpers are suffering from chronic gas poisoning incident to the practice of improper disposing of these spent gases.

Suggestions from yourself and your readers are requested in order to check this menace. S. DANA HUBBARD, M.D.
Supt., Division of Industrial Hygiene.
Department of Health, New York City.

A Question of Inertia

To the Editor of the SCIENTIFIC AMERICAN:

Your issue of October 1, 1921, contained a paragraph headed "Observing the Earth's Movement," wherein it was pointed out that this can be noted in a pail of water, the liquid turning around in relation to the pail. I tried this experiment, with some misgivings as to the result, and can observe no motion whatever. Nor would I expect to, for manifestly when the water had entirely "come to rest," a condition admittedly necessary before starting this experiment, it will have in reality taken up all of the motion of the pail due to the earth's motion, whether of translation or rotation.

However, I do observe a motion of rotation in a pail of water, observed for several hours after filling, which was imparted to it *as the water escapes from the spigot in filling.*

I cannot but believe that this is the motion Mr. Bastin has observed and erroneously ascribed to the rotation of the earth.

Has Mr. Bastin, who contributes this curiosity, or the SCIENTIFIC AMERICAN considered what turmoil would be caused in the oceans were there any tendency for water to "refuse" to rotate with the earth *with enough force to show in a pail!* Imagine the Indian Ocean, or the north Atlantic even, "trying" to rotate clear round in twenty-four hours!

Montchanin, Del. E. PAUL DU PONT.

The Energy of Flies

To the Editor of the SCIENTIFIC AMERICAN:

I wonder whether any of your readers can throw any light on the source from where flies get their enormous stores of energy! Here (South England) large numbers of a small dark kind take up their winter quarters under the roof of my house about October. Every sunny day they emerge and buzz energetically up and down the sunny side of the walls. This they keep up till April or later. Thus for six months they have to keep up their vitality, expend enormous amounts of energy (for their size), have no visible food of any kind, and in the spring lay their eggs. As the sunshine seems indispensable for them to show energy, may it not be possible that in some way they have the ability to draw upon the vast stores of power latent in the atom? And what is true of flies seems true also of other insects.

Torrington, Devon, England. REV. CHARLES T. PARGITER.

Escalators for Deep Tunnels

To the Editor of the SCIENTIFIC AMERICAN:

With reference to your recent editorial on Mr. Bolton's idea for low level rapid transit system for New York City, your objection to such a system on the ground that the elevating cost would prove very expensive is a valid one if the present method of elevating from the New York subways be used.

It occurs to me, however, that the elevating problem in such a transit system might be cheapened considerably by a scheme somewhat similar to that used by the Chicago, Milwaukee & St. Paul Railroad on the mountain divisions in Montana, Idaho and Washington. On this railroad, trains are electrically braked on the down grade with regeneration of current which is turned back into the wires.

My idea is that escalators in place of elevators could be installed to tap such a subway system, in comparatively small shafts driven on an incline instead of vertically. They would be driven electrically, automatically and would not require the continuous services of operators as elevators do; and they could be so connected electrically so as to regenerate and turn current back into the wires or storage batteries when conditions of heavy down travel prevailed. This current could be used in elevating the same people to the surface at places where the preponderance of travel was upward.

I am quite well aware that such a system would involve considerable loss of current in the regeneration system, and that the escalators at best use a great deal of current. But I believe that the economy of labor in operating, together with such small proportion of current as could be recovered, would make escalators considerably cheaper than elevators.

LEO G. HALL.
Chicago, Ill.

Sister Ships That Are Not Twins

To the Editor of the SCIENTIFIC AMERICAN:

Permit me to congratulate you on your editorial of September 24, 1921, "Is Airship Travel Profitable?"

I wish to call your attention to a minor error which, to my mind, does not affect the value of the editorial, but for the sake of future references thereto it should be stated that the R34 and R36 are *not* sister ships in the true sense, as the following table compiled from official British sources will show:

Ship	R33, R34	R36, R37
Length	639 feet 5 inches	672 feet 2 inches
Diameter	78 feet 9 inches	78 feet 9 inches
Height	91 feet 7 inches	91 feet 7 inches
Volume of capacity	1,958,600 cubic feet	2,101,000 cubic feet
Total lift	59.4 tons	63.8 tons
Weight of hull and fittings	36.3 tons	37.8 tons
Number of engines	5	5
Total horse power	1250	1570
Maximum speed, miles per hour	60	65

The differences in the two classes are very small since the important factor of disposable lift of R36 is less than three tons greater than R34.

It is an interesting fact that the Controller of Information of the British Air Ministry issued the following on March 18th, 1921, for the information of the press:

"Since September, 1917, many improvements in details of design and construction and economical use of materials have been effected, resulting in the construction of rigid airships in Germany which have practically doubled the lift of L33 or R33 and increased the speed by 20 m. p. h. Thus, although R33 was only finished so far back as June, 1919, she was, at the time of her completion, already an obsolete ship, and of only about half the performance of the German rigid airships (L 70 class) in commission at that date ——."

Since the R33 class is only a little inferior to the R36 class, it would be of interest to know what the conclusion would have been if a comparison had been made with the L71 now in the hands of the British Air Ministry which has a disposable lift of almost twenty tons greater than R36 and, therefore, could accommodate at least double the number of passengers.

EDW. SCHILDHAUER.
Washington, D. C.

The Flight of Birds

To the Editor of the SCIENTIFIC AMERICAN:

At different times I have seen statements attributing various rates of speed to flying birds. Especially do I remember an article which gave a maximum speed of 110-120 miles an hour to canvasback and teal ducks, otherwise a rate of 170 to 180 feet per second of flight.

Having always been a keen autumn hunter of ducks and geese, wing shooting exclusively, it was necessary to know something of flying speeds and the approximate leads to be given various species in order to avoid a prodigious waste of ammunition. I thoroughly investigated this question during the hunting seasons of 1908-9-10 and 1911, on Long Point Bay on the north shore of Lake Erie.

Windy days furnish best Lake Erie shooting. The prevailing autumn winds are from northwest and southwest, so that ducks travel usually eastward on such days. At point observations were made a narrow tongue of land projects into lake about one mile, ending in a rocky reef. Passing this, flocks usually veered directly northeast to a large inlet and marsh exactly two miles from reef at nearest point by survey. Varying inward or outward to direction of wind, flocks usually followed an elliptical curve of average length of two and three-fourths miles. To cross this space the average time required for teal and bufflehead was three minutes—55 miles per hour. Mallard required four minutes in most cases, with an average of 45 miles per hour.

The problem at issue was the approximate amount of lead to be allowed a duck at height of 35 yards and 40 yards horizontal distance. Allowing for much variation of ammunition and muzzle pressure, it is not safe to estimate speed of shot greater than 600 feet per second, or 50 yards for one-quarter second. In one-quarter second a mallard will fly 16 feet on average, faster ducks 20-25 feet at outset. Apart from velocity of the projectile extremely variable as it is, there is also wind pressure to measure up along with the moving target. Three to four gun lengths is the best lead for mallard passing in direction wind is blowing.

Since ascertaining above facts I have not wasted so much ineffectual ammunition. I have tested speed of teal and canvasback and get good results with lead 30 feet at 50 yards. The percentage of hits is about 65. This would disprove any speed of 120 miles per hour. Geese fly at varying rates, usually 40 miles per hour in open country. If the above facts are of any value to sporting readers they are welcome to them. At least they can easily verify them by actual tests. R. M. J.
Saskatchewan.

Recently Patented Inventions

Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Pertaining to Aeronautics

VARIABLE DIRECTION PROPELLING APPARATUS.—R. S. HEITLER and M. R. TAYLOR, Norfolk, Va. The invention relates to propellers for airships, aeroplanes and the like, and particularly to a variable direction propelling apparatus which includes one or more propellers having an axis of rotation which may at will be adjusted to occupy various angles. A purpose of the invention is to provide an apparatus in which the adjusting means is operable independently of the driving means for the propeller, so that the propeller can be adjusted to any desired position while it is being rotated.

AEROPLANE.—H. J. LE PUL, 202 E. 96th St., New York, N. Y. The object of the invention is to provide an aeroplane arranged to enable the aviator to readily vary the angle of incidence of a wing with a view to insure an easy taking off or landing within a comparatively short space. Another object is to permit the operator to vary the angle during flight to compensate for the variation of the load due to the consumption of the fuel, thereby being able to maintain a uniform rate of speed.

OIL TANK.—A. E. DE SAVE, c/o Grand Hotel, Mexico City, Mexico. This invention has for its object to provide a tank for gasoline which is especially valuable for use on aeroplanes. The tank is constructed with an inner and an outer casing, the latter having an outlet at its bottom connected with a longitudinal tube, so that should the tank be penetrated by a bullet the gasolene will be prevented from sparking therefrom by an elastic, absorbent material between the casings and will leak slowly toward the longitudinally extended tube which will serve to discharge it at the rear of the aeroplane.

Pertaining to Apparel

ADJUSTABLE HAT LINING OR BANDEAU.—M. L. VAN HUELE, 392 5th Ave., New York, N. Y. The object of the invention is to provide an adjustable hat lining or bandeau arranged to permit of securely and quickly adjusting the lining and fastening it in the adjusted position in a hat. Another object is to provide a lining which is simple and durable, adapted to be fastened in a hat without the use of stitches, and to insure the fitting of any style of hat to the wearer's head.

DIAPHRAGM CONFINER. — KATHLYN L. BURNS, 74 5th Ave., New York, N. Y. The invention relates to ladies' wearing apparel and has particular reference to a device for use by corpulent women to confine their busts and so maintain a neat-appearing figure, as well as insuring the utmost comfort with respect to their breathing facilities. The device is intended for use beneath the corset, not only acting as a shield, but confining the flesh in a smoother outline than is possible with a garment worn outside the corset.

Electrical Devices

ELECTRIC LANTERN.—L. A. HORNBURG, 1742 So. 27th Street, Omaha, Neb. The invention relates to self-contained electric lanterns particularly suitable for use as railway signal and switch lights. The object is to provide an electric lantern which comprises a metal container adapted to hold a battery, two electric incandescent lamps, preferably red or white, and a reflector to serve with each light; also switch control and handle. The device is durable, reliable and of expensive construction.

DUPLEX LAMP SOCKET.—W. J. KOENIG, deceased; address R. J. De Ross, 410 E. 29th St., Brooklyn, N. Y. Among the objects of the invention are to provide a lamp socket, such as are commonly used in headlights, with a form of resilient contact carrier for cooperating with a lamp base; to provide a simple but highly efficient contact structure, and to provide a contact carrier adapted for direct cooperation with a lamp base of either two point or single point contact design.

ELECTRIC FIXTURE.—F. L. BUTLER, 740 E. 36th St., Chicago, Ill. This inventor has been granted three patents of a similar nature. The objects are to provide a simple device comprising comparatively few parts, which can be assembled and installed with economy in time and labor. Since the insulating member is adapted to receive an ordinary tube formed with a "running thread," the length of the tube may be varied as required. The device comprises all parts necessary for the effective functioning thereof in ordinary service, and in its assembled condition has the appearance of a more complicated and expensive fixture.

SWITCH.—L. S. SUTLIFF, U. S. Naval Station, Peare Harbor, Hawaii. Among the objects of the invention are to provide a switch for controlling an electric circuit, which may be used as a wall switch, a suspended switch, or a straight line switch; to permit the device to be operated by one hand and which will indicate its position without the necessity of employing the characters "On" and "Off"; to so construct the device that it may be used for the installation of line wires or wires which terminate at the switch.

ELECTRIC FIXTURE.—F. L. BUTLER, 740 E. 36th St., Chicago, Ill. The inventor has been granted two patents of a similar nature, the object of both being to provide a device having means for guiding the electrical conducting wires from the stem through an opening in the wall of the fixture, such means being removable and possessing inherent qualities operating to maintain the same in adjusted position. A further object is to provide a device of the type described that can be manufactured cheaply, consists of relatively few parts, and is thoroughly practical commercially.

BATTERY CONNECTOR.—W. S. DOE, Prospect St., Kent, Ohio. Among the objects of the invention is to provide a battery connector more especially designed for effectively connecting storage batteries in series or multiple when charging the same. Another object is to provide a battery connector which is simple and durable, and one which is non-corrosive, acid-proof, not liable to get out of order, and capable of being used over and over again.

FLASHLIGHT.—W. S. DOE, Prospect St., Kent, Ohio. The invention has for its particular object to provide a switch arranged to permit the user to conveniently and quickly close or open the same to light or extinguish the lamp. A further object is to provide a switch which is simple and durable in construction and composed of few parts, therefore not easily liable to get out of order.

ELECTRIC SWITCH.—W. D. THROPP, 198 Laurel Hill Ave., Norwich, Conn. The invention relates more particularly to the construction of a pendent switch, an object being to provide such a switch with a longitudinally movable slide member which when operated causes the switch-controlling device to quickly move from one position to another.

ELECTRIC CLOTH CUTTER.—F. A. SCALFARO and J. A. MCLEOD, c/o F. Scalfaro, 1410 W. Rand St., Chicago, Ill. An object of the invention is to provide a cloth-cutting device comprising a substantially triangular frame having its rearward side formed into a handle and being adapted to be slidably moved on its base, a cutting blade being mounted at the forward end of the device and an electrical mechanism for operating the blade. The device may be guided as desired, since the cloth is under the observation of the operator until engaged by the cutting blade.

Of Interest to Farmers

DISK SHARPENER.—P. RINK, c/o H. D. Paterson, Easy Way Mfg. Co., Cresco, Iowa. Among the objects of the invention is to provide a device by means of which the disk of an implement, as, for instance, a harrow, cultivator, or the like, may be easily sharpened while in place without the necessity of any motive power other than that provided by the act of drawing the harrow or cultivator ahead with a team or tractor.

MIXER.—G. W. BISHOP, JR., 258 Vincent Ave., Lynbrook, N. Y. The invention has for its object to provide a construction wherein a thorough commingling of fertilizers is secured in a minimum time. Another object is to provide a mixer especially adapted for mixing commercial fertilizer wherein a plurality of different forms of stirring blades are used to break up the fertilizer as it is moved. The machine may be moved by power or manually.

INCUBATOR.—J. KOVAR, address H. Zaarl, Taylor, Texas. The invention relates to an automatic heat regulating unit, and more particularly to a device of this nature intended for use with an incubator. By this system the temperature of the incubator or other device with which it is associated will be constantly maintained at a predetermined point. The device is extremely simple, hence economical to manufacture, and is entirely automatic, so that a minimum of attention is required.

BOG CUTTER, GRUBBER AND WEEDER.—C. A. AMEROSE, Carson City, Nevada. The invention is especially designed to cut weeds and water lilies in ditches, such as irrigating ditches, which become clogged up. The device may be adjusted to ditches of different widths and depths and will efficiently cut the growth along the bottom and sides of the ditch. The device may also be employed on level surfaces for cutting weeds or grub. A further object is to provide a device which may be drawn along by draft animals.

Of General Interest

LADDER.—F. M. DE SAUSSURE, c/o Peerless Folding Ladder Co., Greenville, S. C. This invention relates to step-ladders, which may be readily collapsed, and has for its object to provide a ladder in which the side stiles may be folded on each to house the rungs. A further object is to produce such a ladder as will have the prop legs adjustable and readily locked in erected or collapsed condition, and locking means to prevent accidental collapse.

METALLIC PACKING.—W. L. HARRIS, c/o Roberts, 234 E. 53d St., New York, N. Y. The object of the invention is to produce a metal alloy which is comparatively soft, but has certain qualities especially desirable for packing. This packing comprises anti-friction metal alloy in granulated form 82 per cent, anti-friction metal in wool form 6 per cent, asbestos 6 per cent, grease 3 per cent, mica 1 per cent, graphite 1 per cent, and water 1 per cent.

CONTAINER.—J. MRAZEK, 435 S. 86th St., New York, N. Y. This invention relates more particularly to condiment holders, perfume containers and similar small receptacles, an object being to utilize an eggshell, partly filled with plastic material, as the exterior of the container, the eggshell readily lending itself to painting, decorating and ornamentation of various sorts.

COPY HOLDER.—A. N. WOODRUFF, 461 Hudson St., New York, N. Y. It is the primary object of the invention to provide a copy holder in which a line-spacing mechanism is moved intermittently from the top to the bottom of the writing bed in such a manner that the line being copied by the operator will at all times be positioned above the line indicator.

INSECT PROTECTOR.—L. W. STEVENS, Box 632, Everet, Wash. Among the objects of the invention is to prevent insects from gaining access to roosting hens, or crawling up the legs of furniture. The device comprises a cup within which a quantity of oil or the like is adapted to be received so as to completely surround the standard supporting the fowl roost, or the legs of furniture on which it is used.

BAG HOLDER FOR TRUCKS.—E. E. DURKEE, Deer River, Minn. An important object of the invention is to provide a bag holder for trucks which will not interfere with the use of the truck and which may be applied to a truck without elaborately altering the construction. A further object is to provide a simple means whereby the bag may be securely held on a hand truck and released when desired.

COLLAR BUTTON.—R. A. KAHL, 190 S. Main St., Wallingford, Conn. The purpose of the invention is to provide a button which will permit of ready application and removal of a collar to and from the shirt without distorting, tearing or in any manner injuring the buttonholes of the collar. Furthermore, the invention provides a button and means for preventing the accidental displacement of collar ends having worn or loosely fitting buttonholes.

BOTTLE REFRIGERATOR.—R. J. SOUTULLO, c/o R. W. Shaw, Terminal Pharmacy, N. W. Beauregard and St. Joseph Sts., Mobile, Ala. The invention relates to a bottle container and refrigerator adapted for use in stores or homes, to receive bottles containing milk, soft drinks and the like, so that the same will be retained in a cool and sanitary condition in the same refrigerator receiving the foodstuff, whereby both may be kept cool and fresh with the same refrigerating medium with a minimum expenditure of ice.

PANTOGRAPH.—R. C. EMMERLING, 5th Ann St., West Hoboken, N. J. Among the objects of the invention is to produce a pantograph which shall be so simple as to be within reach of everybody, and which shall lend itself to any number of uses, such as engraving, drafting and manifold, other uses for the purpose of enlarging or reducing. This form of pantograph is particularly desirable where economy is desired.

HAT CONFORMATOR.—D. FREEDLINE, 1250 Fulton St., Brooklyn, N. Y. The general object of this invention is to provide a device of lighter and more simple form than the conformators usually employed. A further object is to provide adjusting means that will readily adapt themselves to the different shapes of heads, at the same time may be locked in adjusted position, against the possibility of changing its form.

BELT BUCKLE.—S. ROSENTHAL and S. D. BRIGHTMAN, 1517 47th St., Brooklyn, N. Y. An object of the invention is to provide a buckle especially designed for concealing the expanding mechanism of the belt and guarding it from contact with the clothing of the wearer. A further object is to provide a buckle which will be neat and attractive, strong, durable, simple, and practical in construction.

CONDIMENT HOLDER.—D. FREEDLINE, 1250 Bulton St., Brooklyn, N. Y. The invention relates more particularly to a dispensing means for salt, an object being to provide a means which operates as an effective closure for the condiment holder when the latter is in its normal position, and which operates to effectually discharge a quantity of the condiment when the holder is inverted and shaken.

MANHOLE COVER.—J. H. THOMSEN, 2014 W. First St., Davenport, Iowa. The object is to provide a cover plate having inner and outer spaced annular ribs formed on the side, spaced pairs of radial arms extending through and turned into said ribs, the inner ribs being provided with openings slidably receiving the inner portions of the pairs of arms, pairs of latch bars carrieds by the outer end of the pairs of arms, and coiled springs confined between the arms for separating and urging the latch bars outwardly.

HOLDER AND TIE.—A. H. EVA, 206 Cumberland Rd., San Antonio, Texas. The object of the invention is to provide a holder for engagement by the laces of shoes, leggings, corsets and the like, wherein a simple, inexpensive attachment is provided, which may be easily connected with the shoe, and in which the end of the lace may be engaged in such manner that it cannot become accidentally displaced.

SWAB.—W. F. LERCH, 941 Glengule Place, Chicago, Ill. More particularly the invention relates to a device for use in connection with iodin or any other liquid, or semi-fluid. An object is to provide a swab which will be entirely sanitary, which will permit the removal of the cotton after application. A further object is to provide means for holding absorbent cotton on the end of the swab which preferably forms a portion of a bottle stopper which operates as a handle.

SPRAYER.—J. T. PLUMER, North End Station, Detroit, Mich. The invention relates to an apparatus for spraying lawns, gardens, or the like. The device more particularly relates to a sprayer employing laterally extending spraying arms mounted to revolve about a vertical axis. The general object is to provide a sprayer with a view to effect a proper distribution of the spray in the gradually increasing zones covered by the sprayer arms and their appurtenances.

WALL BRACKET.—R. F. PERKINS, 29 Webster St., Middleboro, Mass. Among the objects of the invention is to provide a hanger for hot water bottles and the like, having means whereby the flexible tube of the bottle may be supported in such manner that it will not crack. A further object is to provide a hanger having a single hook provided at one end with an attaching loop, and at the other end with a bill adapted to engage a hot water bottle.

HORSE COLLAR.—B. C. WINSTON, Orr, N. D. The purpose of this invention is to provide a horse collar constructed in the main of coiled contractile springs so associated with each other as to provide a collar of durable and efficient construction, and having the required flexibility to render it self-conforming with respect to the horse's neck.

PROTECTOR FOR DESKS.—R. H. MASTERS, 96 Glendale Road, Webster Groves, Mo. The invention has for its object to provide a rubber protector to prevent scarring and splintering of desk edges and the desk chair when they are struck together, the protectors being arranged at such point on the desk edges that they will be engaged by the chair, to prevent injury to either the desk or the chair.

MOUSE TRAP.—N. H. ALBRECHT and W. A. BALDWIN, 413 Sixth Ave., Dawson, Ga. This invention has for its object to provide a trap in the form of a sleeve which may be connected with an ordinary fruit jar at one end, and wherein the sleeve has mechanism in connection therewith for permitting the free entrance of a mouse or rat to the jar, but for preventing the escape of the mouse or rat from the jar.

HAND NUTCRACKER.—H. C. ATWOOD, Box 362, Ardmore, Okla. This invention has reference to a simple nutcracker adapted primarily to be operated by hand. An object is to provide means whereby pressure can be easily applied with sufficient power to crack various kinds of small nuts quickly and without breaking the same into small parts. The device is provided with means whereby it may be detachably mounted on the edge of a table or the like.

PHONOGRAPHIC NEEDLE.—T. FLETCHER, 125 No. Flores St., San Antonio, Texas. An important object is to provide a needle which by being turned upon its longitudinal axis will function as a soft, medium or loud needle. A further object is that by making the shank of the needle more flexible in one position than it is in another it is capable of absorbing most of the strong vibrations communicated to it, and by so doing cut them out from reaching diaphragm, at the same time preserving the overtones which are often lost in reproduction.

LIFEBOAT OR RAFT.—W. STEWART, 18 Taylor St., Newark, N. J. One of the principal objects of the invention is to provide a lifeboat or raft of identical construction on its upper or lower sides whereby the same will properly function irrespective of its launching, thereby eliminating the necessity of expensive tackle for lowering the same into the water. A further object is to include a plurality of water-tight compartments, rendering the same non-sinkable and providing storage room for provisions and water.

UMBRELLA HOLDER.—C. A. COOPER, c/o Mrs. R. Dynes, 676 Riverside Drive, New York, N. Y. Among the objects of the invention is to provide an umbrella holder designed to hold individual umbrellas in erect position and in such manner that any drip water from the umbrella will be conveyed along the tip into the interior of the holder, so that the water will not reach the floor, and yet come as little as possible into deteriorating contact with the crown of the umbrella.

SANITARY FLYTRAP.—A. B. HELLER, Hamburg, Pa. The general object of the invention is to provide a structure provided with locking means and adapted to be set up from a flat form to present a bottom and sides, together with means to retain flypaper supported on the bottom of the structure. The trap is so constructed that the flypaper can not possibly contact with surrounding objects, and the trap may be burned, making it thoroughly sanitary.

FLUE CLEANER.—W. MECHVILLE, R.R. No. 4, Cedar Rapids, Iowa. This invention aims to provide a simple and efficient flue cleaner which shall operate in such a manner as to automatically conform to varying widths of flues, so that upon being moved through the flue the latter will be efficiently cleaned. A further object is to provide a device in which those portions subject to wear may readily be renewed.

WINDOW.—L. LANE, P.O. Box 1066, Habana, Cuba. More particularly the invention relates to windows in which the sliding sashes have line contact with the guide members engaged thereby on the window frame. The object is to provide a construction and arrangement of the jamb members of the frame and the sash members to insure the line contact and be capable of embodiment generally in windows having sliding sashes.

BAG SUPPORT.—MARY C. SPRAGGINS, 1924 Boulevard, Jersey City, N. J. An object of the invention is to provide a bracket or clamping device which may be readily mounted on the table or other support so that the bag will be held in open position for receiving any desired article. Another object is to provide a support for a scrap bag in a sewing-room, general utility bag, or a trash bag, arranged to be supported with its mouth open when in use, and the mouth section folded when not in use. (See Fig. 1.)

ANIMAL TRAP.—A. F. RENKEN, Crete, Neb. This invention relates particularly to a trap which is primarily designed to catch pocket gophers. An object is to provide means for maintaining the trap at various positions of adjustment when the trap is in set position so that it may be suited for use in holes of different sizes. A further object is to provide a metal trap which is simple, strong and practical in use.

FASTENER FOR HANDBAG.—M. SLOANE, 228 Roebling St., Brooklyn, N. Y. The general object of the invention is to provide a fastening upon which reliance may be placed to hold the bag in closed position, and make the surreptitious opening of the bag attended with greater difficulties than when reliance is placed solely upon the clasps or the catch usually provided on bags at the top.

ARTIFICIAL BAIT.—J. FRAME, c/o Penobscot Coal Co., Searsport, Maine. The general object of the invention is to provide an artificial bait with means for giving motions more or less in simulation of the natural motions of a minnow by flexing the articulated tail portion, and by novel fins to cause the bait to turn to one side and rise toward the surface, and to the opposite side and produce a diving action. The hooks have flexible guards concealing them, but yielding to the attack of a fish. Fish oil may be caused to exude from the bait through its tail and sides as a lure. (See Fig. 2.)

ALLOY.—F. MILLIKEN, 18th floor, 110 William St., New York, N. Y. The object of the invention is to provide an acid-resisting alloy capable of being rolled, drawn, forged, or worked in other ways while being cold, to form rods, plates, sheets, wires, tubing and the like. The alloy consists of the following ingredients: Copper, 60-70 per cent, zinc 19-24 per cent, nickel 9-12 per cent, iron 1-2½ per cent, and manganese copper 1 per cent.

MATTRESS.—P. GARDNER, 240 53rd St., Brooklyn, N. Y. Among the objects of the invention is to provide a mattress made up of a plurality of sections which are in a very simple and effective manner completely interchangeable, whereby the supporting surface of the mattress may be very readily changed so that the entire surface of the mattress is uniformly worn out and thus the life of the mattress is greatly lengthened.

CURTAIN SUPPORT.—H. H. DIERKES, 853 95th St., Woodhaven, L. I., N. Y. The invention relates to means for supporting a panel curtain on a door or window. The general object is to provide a device in the nature of a continuous twisted wire adapted to be applied to a window or door frame or separate frame, and having hooks for engaging the curtain at intervals on all four sides so as to give an even support, and loops to receive nails to fasten the wire to the door or window.

CHRISTMAS TREE STAND.—E. A. WILSKE, 3449 Greenwich Ave., Chicago, Ill. Among the objects of the invention is to provide a stand which will serve to rigidly support a tree in upright position and to provide illuminating means associated with the stand for throwing light upwardly on the tree. A further object is to provide a varicolored translucent revolving element which will serve to give a constantly changing illumination to the tree. (See Fig. 3.)

REEL.—R. CASSIDY, 12 W. 1st St., Mansfield, Ohio. This invention relates more particularly to reels designed for use in connection with clotheslines. An object is to provide a device which will permit the clothesline to be reeled or unreeled without any portion coming in contact with the ground to soil the line. A further object is to provide a reel which is portable and can be conveniently supported in one hand and manipulated by the other.

LETTER SHEET.—D. D. SCHULMAN, deceased; address Florence R. Schulman, 416 W. 33rd St., New York, N. Y. The objects of the invention are to provide a commercial letter sheet adapted to carry a display advertisement of goods, such display being of pictorial character and of fixed form, such as that standardized by the manufacturer in obtaining publicity, but which picture shall not trespass upon the sheet reserved for written communications.

ADJUSTABLE JAR COVER OPENER.—J. A. MCLEOD and ELLA A. DAUTOR, 744 S. Campbell Ave., Chicago, Ill. Among the objects of the invention is to provide a jar cover opener that can be readily and quickly adjusted to positively grip the top of any bottle, jar, or the like, to remove the same. A further object is to provide a device which is simple in construction and operation, and which is not likely to easily get out of order.

SHEET METAL BACKING FRAME.—J. MANDEL, 1805 1st Ave., New York, N. Y. The invention relates to backing frames for advertising cards, and has for an object to provide a construction in which a plurality of sheet metal members are telescopically arranged for receiving a single card or a plurality of small cards without changing the general appearance of the device, and giving a uniform edge so as to have the appearance of a complete frame for each card.

FLASHING.—O. BOLL, 416 Stevens St., West Hoboken, N. J. This inventor has been granted two patents of a similar nature. They relate to flashings such as are employed on a building at the siding, on a roof, at a window or door frame, or in connection with a chimney. The general object of the invention is to promote facility in the proper installation of a flashing and the securing of the same in position and provide for ventilating the space beneath the flashing owing to the sweating of flashings at the interior and to provide a flashing that may be wholly or partially removable in making repairs.

FILM WINDING MEANS FOR CAMERAS.—H. H. BERRY, 2735 Webster Ave., Bronx, N. Y. Among the objects of the invention are to provide means for causing the turning of the winding spool by a slidable actuating device accessible from the exterior, as well as means to vary the winding action to accord with the increasing diameter of the spool as the film is wound thereon.

FRUIT PICKER'S BAG.—W. F. KEELINE, deceased; Mrs. W. F. Keeline, 445 Main St., El Centro, Calif. The object of the invention is to provide a bag whose upper portion is held open at all times adjacent to its receiving mouth and has at the same time a flexible portion adjacent to the user's body to avoid the discomfort of rigid, unyielding or still bag mouth supports as commonly used at the present time. The invention is particularly intended to provide comfort for the user. (See Fig. 4.)

COFFEE CAN AND ATTACHMENT.—W. S. MILLER, 1135 4th St., San Diego, Calif. The invention has for its object to provide means for delivering a predetermined quantity of the contents of a can without opening the can, and thus preserving the aroma of the coffee or other contents. Another object is to provide an airtight removable cover for the receptacle, a raised horizontal bottom in which is placed a measuring device in the form of a rotatable cylinder with openings for filling the cylinder from the contents of the can and closing the same that the contents of the cylinder may be emptied.

TRAP NEST.—J. F. COOK, 846 Brunswick St., San Francisco, Calif. An object of the invention is to provide a poultry nest which can be so arranged as to train a hen to use a certain nest which will facilitate the keeping of records. Another object is to provide a nest which is capable of use as a trap of such character that when the hen enters the nest egress will be prevented, or it may be arranged to permit perfect freedom of ingress and egress.

ROLLING CRUTCH.—M. D. SCOTT, 214 No. Tremont St., Kewanee, Ill. The invention relates to what is known as walking chairs, having in connection therewith a seat whereby the user may propel himself along and readily and easily rest between walking periods. The primary object is to provide an arrangement by which the seat is readily shiftable and horizontally adjusted, and in which the arm rests may be conveniently adjusted to the body of the user.

REMINDER.—W. H. COLLINS, 200 Boulevard, Summit, N. J. The invention has for its object to provide a construction which will be applicable as a kitchen reminder or as a reminder in any other place, and to provide means for presenting to view in a classified manner a large number of articles needful in a house or other place, the indicating members being slidingly mounted in slots formed with a series of depressions for holding the members at any desired point.

HOLLOW TILE.—J. V. CLOSE, 74 Franklin Ave., Norwalk, Conn. Among the objects of the invention is to provide a hollow block or tile construction which will make it impossible for moisture to pass through the wall, following the courses of the mortar. Another object is to provide what may be termed a combination hollow tile having peculiar facilities for adapting it for the formation of special structures, such as corners, turns or walls of irregular length.

TABLE.—G. E. TOMLINSON, Winchester, Ky. An object of this invention is to provide a sectional or collapsible table composed of a minimum number of parts, which can be quickly and readily put together to form a strong, compact table. The table comprises a top which may be in one piece or may be composed of pieces, and the device is fastened with resilient locking means, the entire structure being collapsible and composed of parts which can be quickly dismantled and stored in the smallest possible space.

Hardware and Tools

WRENCH.—A. W. MINNEY, 231 E. Freemont St., Stockton, Calif. The object of this invention is to provide a wrench which is simple and durable in construction, reliable in operation, readily adjustable, and which is adapted to powerfully grip the object or work and to apply a powerful torque thereto without distorting or breaking the elements of the wrench.

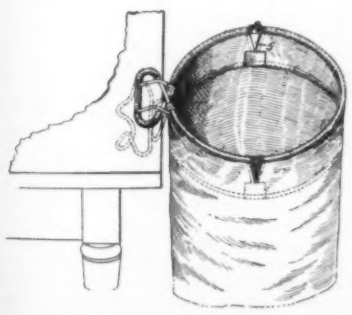


Fig. 1.—This bag support is the invention of Mary C. Spraggins, of Jersey City, N. J.

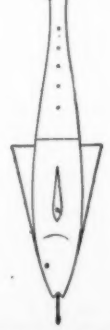


Fig. 2.—An ingenious artificial bait, patented by J. Frame, of Searsport, Me.

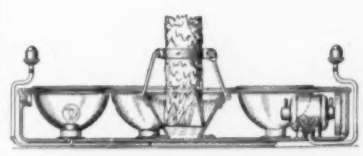


Fig. 3.—This elaborate Christmas tree stand with flood lights and motor-driven color-wheel for providing varicolored lights, is the invention of E. A. Wilske, Chicago, Ill.

Fig. 4.—A fruit picker's bag whose upper portion is held open at all times—the invention of W. F. Keeline

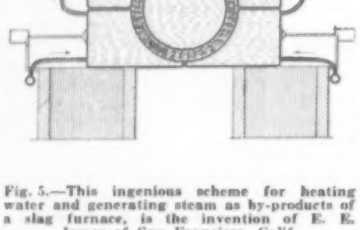


Fig. 5.—This ingenious scheme for heating water and generating steam as by-products of a slag furnace, is the invention of E. E. James of San Francisco, Calif.

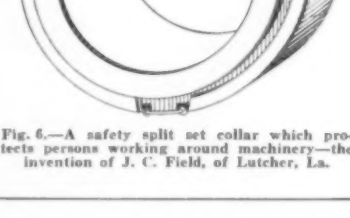


Fig. 6.—A safety split set collar which protects persons working around machinery—the invention of J. C. Field, of Lutcher, La.

Fig. 7.—This simple tool serves to engage the valve tappet so as to impart a grinding movement. Invention of H. C. Brown, Philadelphia, Pa.

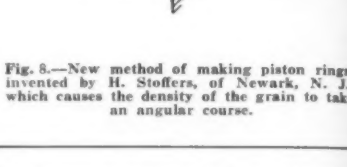


Fig. 8.—New method of making piston rings, invented by H. Stoffers, of Newark, N. J., which causes the density of the grain to take an angular course.

SAW-FITTING TOOL.—G. ANDERSON, 222 Minor Ave., North, Seattle, Wash. Among the objects of the invention is to provide a device including a vertically adjustable swage gage member provided with a plurality of laterally projecting gage points, so located that when gaging the length of a raker tooth of a saw they will be out of registry with the two points of the raker tooth, whereby the unused gage point will not interfere in the operation by coming in contact with the opposite tooth point.

BOILER TUBE BRUSH.—J. BERGESEN, Sr., 261 E. 31st St., Brooklyn, N. Y. This invention has particular reference to a type of brush which is adapted to be forced, in a well-known manner, by means of any suitable fluid pressure, through the tubes of a boiler to clean the same. An object is to provide means whereby the brush will not cant or jam in the tubes, and to provide means for clamping the bristles on the brush in such way that they can be very easily removed.

TOOL HOLDER.—B. T. CARSON, Kinderhook Knitting Co., Kinderhook, N. Y. The invention relates to lathe tools. The device consists of an attachment in the nature of a locking or retaining device which seeks for its object to provide a positive means for clamping the yoke in its adjusted position and locking the tool against relative movement with respect to the holder. The attachment is simple and inexpensive.

SAW SET.—J. W. INGLETON, Box 962, Astoria, Ore. The invention relates more particularly to a readily adjustable device of this nature which is of simple construction, may be conveniently utilized and will be durable and effective. The device is adaptable by virtue of its adjustments to both cross-cut and hand saws, and may be utilized with but slight change for saws of various types.

PACKING TOOL.—K. BERGSKAUG, 309 Warren St., Brooklyn, N. Y. The invention relates to a packing tool particularly adapted for use in connection with the packing of tubes. One of the principal objects is to provide a device which shall be simple in construction and may be operated by relatively unskilled labor in the application of packing material to the ends of tubes and heads applied thereto, by means of which the tube will be evenly and correctly packed.

WINDOW OR KEY LOCK.—B. LEICHTER, c/o Davis, 52 Smith St., Brooklyn, N. Y. The invention relates to builders' hardware. Among the objects is to provide a safety device for cooperating with a locking member or catch which, when in adjusted position, will serve to prevent or materially reduce the likelihood of the catch or lock being moved or released to permit the opening of the window or door by any unauthorized person.

WRENCH.—A. W. MINNEY, Stockton, Calif. The object of the invention is to provide a tool which is especially adapted for use as a wrench and adapted, when so used, to powerfully grip either round or polygonal objects irrespective of the position of the wrench with respect to such objects, and which is of simple and durable construction, reliable and easy to operate.

HUB FOR GEARS, PULLEYS AND TOOLS.—J. L. GLENDENON, R. No. 1, Box 75, Ensley, Ala. The invention relates to gears, pulleys and the like, or tools, and more particularly to a hub construction therefor, by which the body or rim of the gear, pulley or tool is detachably fixed to the hub, so that the part subject to wear and tear may be removed for repair in case of breakage, or for changing speeds where the same hub may be used for different sizes of gears or the like.

MICROMETER CALIPER.—G. COUSINS, 173 W. 1st St., Oswego, N. Y. An object of the invention is to provide a readily adjustable, easy reading arrangement which will obviate the necessity for a vernier, and will permit of easy interchange of spindles for different classes of work. A further object is to provide an apparatus in which the various portions are detachably connected so as to facilitate their removal for purposes of substitution and repair.

NIPPLE GRIP.—W. P. STRICKLAND, 4532 Cottage Grove Ave., Chicago, Ill. This invention has for its object to provide a device for engaging a spoke of a bicycle or the like and the spoke nut thereon to permit operation of the latter without subjecting the device to a lateral stress. A further object is to provide a device that can be quickly adjusted and easily engaged with work of various sizes, which contains comparatively few parts, and is therefore durable and inexpensive to manufacture.

DOOR OPENING AND CLOSING DEVICE.—G. C. CIRAC, c/o R. A. Cahalan, Evans and Railroad Ave., San Francisco, Calif. The invention has reference more particularly to a manually operated device which is adapted to be mounted in association with a door for opening and closing the same, and further is a convenient means for locking the door closed when occasion arises. The invention is especially adaptable to the doors of ice boxes and like compartments.

TRAPPER'S TOOL.—W. R. LAZENBY, Box 451, Hardin, Mont. Among the objects of this invention is the provision of a combination tool which will greatly facilitate the setting and removal of a trap, and which will afford convenient means for preparing the ground to permit of the positioning of the trap and trap anchor. Another object is to provide a tool which may be folded to occupy a minimum amount of space when not in use, whereby the same may be carried easily as a part of the trapper's outfit.

TWISTING TOOL.—J. SCHNEIDER, 412 Walnut St., Rochelle Park, N. J. The invention relates to twisting tools generally used for splicing wires or strands. An object is to produce a tool having special facilities for rendering it capable of use on splicing work where various sized splicing sleeves and strands are necessarily employed. It is also an object to produce a tool having convenient clamping means for mounting the device on parts to be twisted.

Heating and Lighting

FISH COOKER.—A. S. DAVIES, 44 Garfield St., Santa Cruz, Calif. An object of the invention is to provide a cooking apparatus to be used in connection with fish canneries, an endless belt traveling through a cooking chamber being employed to convey and continuously cook the fish. Another object is to provide a screen of porous material between the fire chamber and cooking chamber to hold down the flames and absorb the oil dripping from the fish as it cooks.

SLAG FURNACE.—E. E. JAMES, 221 Mason St., San Francisco, Calif. The invention refers particularly to an apparatus for heating water and generating steam by means of utilizing the existing heat in the slag of blast furnaces. An object is to produce an apparatus which will be capable of utilizing large quantities of slag. The apparatus comprises a steam boiler and means for confining a quantity of hot slag around the same, the lower portion of said means being capable of removal from the bottom of the boiler to release the exhausted slag. (See Fig. 5.)

ARCH FOR FIREBOXES.—F. J. SPILLANE, address Mack Engineering & Supply Co., 123 Liberty St., New York, N. Y. The invention relates to oil-burning steam boilers. Its object is to provide an arch arranged to permit of readily assembling the sections at the ends of the fireboxes and to allow of readily removing or replacing a burned-out section. Another object is to provide a protecting means for the joint formed by the firebox with the back flue sheet with a view to preventing flames reaching the joint and to prevent a too rapid cooling of the joint after the flame is extinguished.

REGULATOR.—I. J. FOLTZ, 508 1st Ave. So., Seattle, Wash. An object of the invention is the construction of a regulator for use in connection with a gas burner by means of which the burner may be caused to produce a "pilot" size flame or one in which the entire battery of burners may exert their maximum output, the gas being thrown straight into the mixing tube of the burner to produce an ideal mixture and a good flame.

HYDROCARBON BURNER.—A. KAUFMAN, 2529 E. 79th St., Cleveland, Ohio. Among the objects of the invention is to provide a burner possessing efficiency with respect to the amount of fuel consumed and the degree of heat that it is capable of delivering, to provide a burner that is clean, sanitary, and inoffensive, and one which has satisfactory, lasting qualities. A further object is to simplify and improve the construction of the gas generator with respect to durability.

THERMOSTATIC TRAP.— R. N. TRANE, c/o The Trane Co., La Crosse, Wis. The invention relates to thermostatic valves or traps for radiators or other steam appliances, and has for its object to provide a construction which will be both sensitive and powerful. A further object is to provide a trap with a thermostatic member for opening and closing the valve, and a double valve structure to take care of high pressures, and a small valve forming part of the head of the valve, sensitive to small changes in temperature as well as acting in connection with high pressure.

Machines and Mechanical Devices

TEST INDICATOR.—G. J. GENUNG, 904 10th Ave., Beaver Falls, Pa. The invention has for its object to provide a device of the character specified, for permitting the accuracy of surfaces to be determined, wherein small openings of considerable depth may be measured. This device permits the operator to test or gage the entire surface of a long hole of relatively small diameter or to reach into a small aperture of a jig or any other piece of machinery to be tested.

SAFETY SPLIT SET COLLAR.—J. C. FIELD, Lutcher, La. The invention more particularly relates to a split set collar designed to afford safety to persons working about machinery, so as to prevent catching one's clothes thereon and obviating the danger of wrapping or winding clothing thereon, due to the fact that the device has no open spaces on its face or protruding screws or bolts as in the ordinary set collar. The collar may be quickly installed without removal of the shaft, and affords an absolutely smooth exposed surface. (See Fig. 6.)

PUMP.—J. A. WHITLING, Box 186, Healdton, Okla. The object of the invention is to provide a pump especially adapted for use in deep wells, wherein means is provided in connection with the pump for settling the sand before it comes into contact with the valves and piston, and wherein other means is provided with the piston for preventing the entrance of sand to the plunger or piston and between the packing thereof and the barrel.

VALVE AND GRINDING MECHANISM THEREFOR.—H. C. BROWN, 43 E. Logan St., Germantown, Philadelphia, Pa. Among the objects of the invention is to provide a valve and a grinding mechanism therefor which may be moved into locked engagement with the valve to impart a simultaneous rotary and longitudinal movement in both directions during the grinding operation, for which purpose the inventor provides a special tool comprising a shank and fixed jaws. (See Fig. 7.)

THREAD CUTTING AND TAPPING MACHINE.—E. JONES, Luverne, Minn. An object of this invention is to provide means for supporting and mounting a longitudinally movable chuck and provide means for turning the chuck in either direction. A further object is to provide means for clamping the work either in a horizontal or vertical position, and to produce a machine which will be simple, strong and durable in use.

SEWING MACHINE ATTACHMENT.—D. KWON, c/o Bailey Furniture Co., Honolulu, Territory of Hawaii. More particularly the invention relates to an attachment adapted to be connected to the head of the sewing machine and support the extension board when the latter is folded, and when the machine is to be dropped preventing injury to the board and to the machine. The attachment will not interfere in any way with the operation of the machine.

PROTECTING OBJECTS FROM WAVE ACTION—P. BRASHER, 11 Broadway, New York, N. Y. The invention relates to means for protecting objects from wave action, and more particularly to a means of discharging air upwardly from perforated pipes through the water for breaking up the waves, a further object being to provide means for discharging from the apparatus sand or foreign matter accumulating therein.

METHOD OF MAKING PISTON RINGS.—H. STOFFERS, 471 So. 14 St., Newark, N. J. The invention particularly relates to hammered piston rings. By the usual method the impact of the blows are liable to cause slightly raised and hardened spots on the outer peripheral face. By this invention an annular groove is provided having angular walls against which the force of the hammer blows are received. By this arrangement the density of the grain formed is forced to take an angular course, thus producing the hardened spots on the upper or lower edges of the ring. (See Fig. 8.)

SILK THROWING MACHINE.—P. H. BONNER, 104 E. 25th St., New York, N. Y. The object of the invention is to provide a machine arranged to form from two or more raw silk ends a crape or high twist thread in one continuous operation on a single machine. Another object is to produce a large amount of crape thread in a comparatively short time, and one having a uniform twist throughout its length.

JACQUARD DRUM.—G. C. L. TISCH, 454 Spring St., Elizabeth, N. J. The object of this invention is to provide a construction wherein a drum or wheel structure is used for holding the pins instead of an ordinary link structure. A further object is to provide knitting machines with means for carrying a series of pins capable of acting on the needle bars correctly, and preventing any appreciable tilting or loose side motion of the pins.

COLLAPSIBLE CORE.—P. DE MATTIA, Clifton, N. J. This inventor has been granted three patents of a similar nature, the objects being to produce a collapsible core comprising a plurality of articulated sections so constructed and connected together as to afford a maximum of movement to the pivoted parts and thus greatly facilitate the removal of the built-up shoe or casing without subjecting the same to distorting stress or pressure. A further object is to provide a key section with means to move the same radially and in an oblique direction, and to provide means whereby the key section may be entirely removed and supported within convenient reach of the operator.

APPARATUS FOR AND PROCESS OF MAKING PNEUMATIC TIRES.—B. DE MATTIA, Clifton, N. J. The object of this invention is to provide a simple form of apparatus whereby cylindrical tire blanks may be pressed and shaped by means of and in the molds in which the vulcanizing takes place, and a further object is to effect the simultaneous expansion and lateral compression of the cylindrical tire blank, and to

provide means and a process whereby, if desired, a reinforcing inner lining may be applied during the process of expanding.

VALVE CONTROL FLOAT.—C. EIMKE, 4909 Sixth Avenue, Brooklyn, N. Y. This invention refers particularly to a float construction especially designed for use in connection with the supply valves for ink reservoir tanks of large printing presses. One of the principal objects is to provide a float construction of extremely buoyant material, and to provide means to prevent the sticking or adherence of the same to the sediment on the top and bottom of the tank. Another object is to provide a float so shaped as to induce its lifting power under all conditions.

GUARD FOR PUNCHING MACHINE.—S. B. WOODWARD, 213 Rosemount Ave., Trenton, N. J. An important object of this invention is to provide for punching machines which may be attached to either side and which will effectively prevent the operator from being injured when the movable die member carried by the ram descends. A further object is to provide a guard having means whereby the zone of action of the same may be adjusted.

FRUIT SIZING MACHINE.—A. H. MCINTYRE, Dunedin, Fla. This invention has for its object to provide a machine particularly adapted for sizing peaches and similar fragile fruits in which a relatively slow operating machine shall have a relatively large capacity and in which the fruit shall be gently supported, transported and separated into lots of substantially uniform size, without the liability of bruising and injuring the fruit.

AUTOMATIC TRIP MOTION.—M. BERNAUDIN, c/o Dr. Van Schuck, 472 West End Ave., New York, N. Y. The invention relates particularly to a trip motion applicable to use with printing press. An object is to provide a simple compact and readily attachable means for any ordinary printing press whereby the paper-feed roll may be moved to a non-printing position whenever the paper is not gripped and moved to the printing position.

MACHINE FOR MAKING HAT LINING TIPS.—R. BELL, 27 Bond St., New York, N. Y. An object of the invention is to provide a machine which will automatically moisten part of the hat lining immediately before the tip is manually pressed. A further object is to provide a machine formed with moistening and pressing means acting in certain relation to each other for causing the adhesive to flow into the body or covering of a lining tip and thereby dispense with the use of stitching for holding the parts together.

PUMPING MECHANISM.—E. S. LIDSTONE, Box 203, Gatun, Canal Zone. Among the objects of the invention is to provide a pumping mechanism capable of being quickly assembled and disassembled and packed in a small space when disassembled, which is particularly advantageous when the pump is to be used in connection with automobiles. Another object is the provision of a plurality of cylinders so that the pumping action may be rapid.

BOX FINISHING MACHINE.—A. BELL, 319 Teaneck Road, Ridgefield Park, N. J. Among the objects of the invention is to provide a finishing machine for paper boxes which will function to obtain a more perfect finish to the box than is possible by hand labor, in which means is provided to compensate for the great variance in the size of the boxes and lids, and in which means of adjustment can be obtained whereby the same will properly handle boxes and lids made from material of different thicknesses.

BORING MACHINE.—W. F. MCCARTY, c/o Defiance Machine Works, Defiance, Ohio. Among the objects of the invention is to provide a machine designed to quickly and accurately rough bore and ream or finish single units or a plurality of units cast en bloc. Another object is to carry out several boring operations simultaneously on a corresponding number of castings while the attendant of the machine removes the finished product and replaces it by another casting to be bored.

UNIFORM MOTION UNIVERSAL JOINT.—W. J. FRANCKE, Highland Park, N. J. An object is to provide a uniform motion universal joint arranged to insure a uniform transmission of power from the driving shaft to the driven shaft irrespective of the angular position of the shaft. Another object is to positively drive one shaft from the other with the angular advance of the hubs or flanges uniform.

WEAVING MACHINE.—J. L. REYNOLDS, 625 Broadway, Astoria, Ore. The particular object of the invention is to produce a machine especially adapted for making screen fabric from relatively heavy metallic rods. A further object is to provide a weaving machine which is extremely simple, inexpensive to manufacture and maintain and which is capable of speedy production of a high-grade metallic fabric at a minimum cost.

GRAIN DRIER.—W. PUTNAM and G. D. LONGMAN, c/o Longman Bros., Thorrswell, La. The invention relates to an arrangement of racks consisting each of a series of revolving screens or cylinders which serve to propel the grain through the drier and allow a free circulation of air to thoroughly dry the grain, the air being heated at one point in the circuit and after passing through the drier returns to such heating point, so that the same air can be utilized in a continuous circulation.

FLEXIBLE COUPLING.—W. J. FRANCKE, Highland Park, N. J. Among the objects of this invention is to provide a flexible coupling arranged to readily compensate for angular or parallel misalignment of a driving shaft and a driven shaft. A further object is to reduce the error of transmission to within the limit of the thickness of the lubricating film between the working parts.

COLLAPSIBLE SHAFT.—H. T. RICE, L.B. 375, Norfolk, N. Y. An object of the invention is to provide a shaft which is capable of expansion and contraction and the means employed for adjusting the diameter is positive in its action. A further object is to provide an expansion shaft which dispenses with the necessity of springs and like devices, and which is of extremely simple construction, strong and durable in use.

APPARATUS FOR MAKING ORNAMENTAL ROPE.—C. A. REED, Williamsport, Pa. The invention relates to an attachment for sewing machines. The purpose is to provide an apparatus which simultaneously stitches and cuts strips of paper comprised in the ornamental rope, so that when the strips are subjected to twisting operation, by a device separate and independent from the present invention, the ornamental rope is produced.

WHEEL AND SHAFT.—J. C. HUDSON, Box 486, Gorman, Texas. An object of the invention is to provide a wheel and shaft of the character known as ball and calf wheels used in drilling oil and gas wells, wherein the shaft is provided near each end with a hub or polygonal cross section, and the wheel body, consisting of a hub portion, a rim and connecting spokes, has the hub portion shaped to fit upon the polygonal hub of the shaft, the parts being secured together to provide a rigid structure.

DYNAMIC SYSTEM ADAPTED TO IMPART TO A MECHANICAL SYSTEM A RAPID MOVEMENT OF OSCILLATION.—L. L. B. DENIS, 116 Boulevard de Manilmontant, Paris, France. This invention relates to a dynamic system permitting to impart to a non-rigid mechanical system a rigid movement of oscillation, with the minimum of loss work by effects of inertia and by avoiding the prejudicious effects of resonance. The system is characterized by the combination of an elastic system through the medium of which the system to be actuated is connected to a fixed point.

CHECKING MACHINE.—F. R. WAINWRIGHT, 223 7th St., Jersey City, N. J. An object of this invention is to provide a checking machine which will permit of the making of a permanent record, so that slips may be tallied with this record, as well as with the cash on hand. The machine includes a plurality of projectable type-carrying members, movable inking strips adapted to normally bear against the type to permit the same to render an imprint, the type carried by the members moving the strips out of their path of travel upon being projected.

I-BEAM TROLLEY.—W. S. HALSEY, care of Dover Hotel, Dover, N. J. The invention relates to overhead trolleys. Its object is to provide an I-beam trolley having means partly disposed between the web of the I-beam and the adjacent end of a truck wheel for supporting the latter for rolling contact with the lower flange of the I-beam. A further object is to provide a device so constructed that the journal pin for supporting the wheel can be reduced to a minimum and the friction reduced without the necessity of providing anti-friction bearings.

PRINTER'S CHASE.—E. JACKSON, c/o C. J. O'Brien, 22 N. William St., New York, N. Y. The object of the invention is to provide a printer's chase arranged to hold securely the type suspended without danger of dropping out in handling the chase. Another object is to permit of filling the chase completely with type and without requiring the use of quoins and other filling and locking furniture.

LABEL FEED DEVICE.—J. Q. LEAVITT, address H. L. Harrington, Utah Canning Co., 29th St. and Pacific Ave., Ogden, Utah. The invention relates more particularly to devices for feeding labels to be fixed to the ends of cans on which a daub of paste or adhesive has been previously located so that the contact of the adhesive on the can with the label will remove a single label from the feed device.

WAX MELTING MACHINE AND SEAL MAKER.—J. A. CLIFTON, Nos. 9-11 Edisto Bldg., Orangeburg, S. C. The object of the invention is to provide a container for holding a quantity of wax, and having means for heating the wax to melt the same and for delivering small quantities when desired on to the object to be sealed, as, for instance, a document or package, and having means operable at will for making an impress on the wax delivered on to the object to be sealed.

STAYBOLT CHUCK.—G. COUSINS, 173 W. 1st St., Oswego, N. Y. The invention relates generally to the manipulation of staybolts in screwing and removing the same from operative position wherever used. The object is to provide an effective, strong and durable implement by which to engage and rotate a staybolt in either direction, and a still further object is the provision of an implement in which the jaws may be readily adjusted and actually forced into operative connection with the projecting portion of a staybolt.

BLOCK MOLDING MACHINE.—J. S. DOWNARD, c/o The Continental Asphalt & Petroleum Co., 1615 American Exchange Bank Bldg., Dallas, Texas. The invention particularly relates to a machine for molding blocks or bricks from viscous materials such as asphalt or mixtures thereof of the type wherein dies both above and below the molds operate to compress material. The purpose of the invention is to provide a machine which effects the granulation of the material during the period in which the charge overlies the mold, thus reducing it to a uniform state so that it will gravitate into and completely and evenly fill the mold.

PUMP.—M. E. FOSS, Box 3, Wilder, Minn. Among the objects of the invention are to provide a double cylinder pump, each cylinder of which is double acting, thus providing what is in effect a quadruple acting pump, fluid being drawn into the pump and ejected from each end of the barrel at each stroke of the plunger in each direction.

REPRODUCER FOR TALKING MACHINES.—W. T. LAKIN, Long, Md. One of the foremost objects of the invention is to provide a reproducer having a balanced needle bar capable of lateral adjustment in the direction of vibration of the diaphragm to vary the pressure on the diaphragm and consequently alter the pitch. A further object is to provide a reproducer having a balanced needle bar fulcrumed in the plane of the diaphragm.

PRINTING PRESS.—A. ANDERSON, Lincoln, N. J. The primary object of the invention is to provide a mechanism for reciprocating the bed of a printing press. It is a further object to so construct the mechanism that the bed is reciprocated by power which is supplied in a continuous rotary direction. It is a still further object to so construct a device that the lateral or transverse braces of the bed frame as commonly constructed do not have to be changed.

CINEMATOGRAPHIC MACHINE.—E. PLUDERI, Turro Milanese, Italy. The invention especially relates to machines for films having several photographs on horizontal sets and provides the means for a step by step horizontal displacement of the car or slide, said means serving also as a guide during the displacement of the car. The machine serves both to obtain the photographs on the film and to project the film photographs on a screen.

TURBINE.—F. E. KUBE, 614 10th Ave., Clinton, Iowa. The particular object of the invention is to provide a steam turbine having a construction of rotor in which the steam is admitted axially, then directed radially, and then circumferentially in contact with the blades or vanes in a circular series so as to utilize the full kinetic energy of the steam in its passage in order to impart motion to the rotor. A further object is to provide an arrangement of governors and valves for automatically obstructing the passage of steam in starting the rotor.

MANUFACTURE OF BRICKS.—F. BRETTSCHNEIDER, Raitz, Moravia. The invention relates to a device for molding solid or hollow bricks from plastic material, especially chamotte. The process renders it possible to produce bricks of uniform shape and dimensions with level surfaces exactly corresponding to the mold, the possibility of expansion or distortion of the surfaces after removal from the press being eliminated.

CUTTER BLADE GRINDER.—C. F. ROBBINS, 17 Taylor St., Keene, N. H. An object of the invention is to provide a machine which is especially designed for grinding cutter blades of irregular shape, such as are used in the woodwork in art, where the cutters must be of an exact shape and ground repeatedly without altering the shape. A further object is to provide a machine which will grind blades of reverse shape; that is, blades which are designed for use as right and left cutters.

CLOCK ESCAPEMENT.—H. C. SAUL, Douglas, Wyo. The invention has for its object to provide a clock escapement so arranged that a smooth and accurate operation of the parts will result and friction be reduced to a minimum. The invention is characterized by a novel device functioning imparting impulses to the pendulum in response to the operations of the scape wheel. More especially the invention embodies means to adjust the impulse device to regulate its engagement with the scape wheel and means to manually vary the amplitude of movements of the pallet.

PROCESS OF RENDERING FATS AND OILS.—C. F. KAMRATH, Box 691, Denver, Colo. An object of the invention is to provide a process by means of which fats or oils may be so rendered as to effect a neutral product, at the same time eliminating much work that is ordinarily required. A further object is to provide a means by which the rendering is conducted at a low temperature, and simultaneously with the removal of moisture by evaporation under a vacuum.

AUTOMATIC BALL MILL FEEDER.—H. H. BURHANS, 11 So. 14th Ave., Mt. Vernon, N. Y. The invention relates to a rotary crushing or grinding device and a motor for driving the same, a feeder connected with the device for delivering material to be ground, and means actuated by variations of power consumed in the motor independent of the motor speed for automatically varying the quantity of the feed.

TUFT YARN SPRING CLIP.—A. T. THOMPSON, Rogers Ave., Hightstown, N. J. This invention relates more particularly to looms for weaving tufted fabrics such as tapestry, and particularly Axminster rugs. An object is to provide means for permanently securing the springs in position adapted to be used in conjunction with the end members of the tuft yarn frame bar and prevent them from working loose during the operation of the loom. A further object is to provide a spring which requires no extra attaching parts or guards, being a complete spring in itself.

Medical Devices

CLASP FOR TEETH.—E. R. NEBELING, 8 Windsor St., Woodhaven, L. I., N. Y. The invention relates to dental appliances. Among the objects is to provide means for attaching artificial teeth to natural teeth. It is a further object to provide means by which the artificial teeth may be removably secured to the natural teeth. The device comprises an enlarged body portion provided with an opening and a reduced tongue projecting from the body portion.

DENTAL COTTON HOLDER AND WASTE RECEIVER.—N. T. WOOLSEY, 408 Elliott Ave., Tottenville, S. I., N. Y. An object of the invention is to provide a cotton holder and waste receiver more especially designed for use by dentists, arranged to enable the dentist to keep a supply of bunched dental cotton on hand for a day's work, and to permit of readily disposing of the soiled cotton without exposing either the dental cotton or the waste. A further object is to keep the cotton in a sanitary condition prior to use.

Musical Devices

SHEET TURNER.—W. A. LUCKE, General Delivery, Albany, N. Y. The object of the invention is to provide a device more particularly adapted for use in connection with instruments of various types by means of which it is possible for the operator to effect a turning of a sheet of music without any delay and confusion. A further object is to construct a device which shall be practically automatic, in that it will be necessary for a performer to exert a minimum of effort to effect a turning of the sheet.

PIANISSIMO DEVICE FOR GRAND PIANOS.—J. A. HUSSEY, 25 Lisle St., East Braintree, Mass. The object of this invention is to reduce the hammer stroke without changing the position of the key, to so construct the pianissimo mechanism that it can easily be applied to any standard make of action, to provide a device in which a normally inclined thrust rod is arranged for movement into upright position between a key and an action support, to move the latter toward the strings, and to make a simple and durable device.

Prime Movers and Their Accessories

INTERNAL COMBUSTION ENGINE.—L. B. JOYNER, c/o L. S. Haas, 204 S. Main St., Chicago, Ill. An object of this invention is to provide a device with means for cooling the pistons and parts associated therewith and for reciprocating the pistons with the cylinders. Air chambers are carried by the water supply pipes and serve to reduce the noise occasioned by the rush of the cooling fluid through the fluid-conducting passages.

SIGHT FEED DEVICE.—O. C. NORTON, Roodhouse, Ill. This invention has for its object to provide a device of the character specified adapted for use with internal combustion engines to feed water to the manifold, wherein the amount of water fed is under observation, and can be easily regulated to the required amount. The device is

also adapted for use as a primer for use on cold mornings, when the motor usually starts with difficulty.

CARBURETER.—W. ASHWORTH, 9 Hoosac St., North Adams, Mass. Among the objects of the invention is to provide a carbureter including a venturi, comprising two annular sections fitted together, each of the sections being formed with air by-passes, and means for automatically moving one of said sections with respect to the second for the same for aligning the air by-passes and regulating the passage of air through the same in direct ratio to the speed of the engine with which the carbureter is associated.

Railways and Their Accessories

TRACK.—G. H. PEIFER, c/o Anthracite Motor Sales Co., 240 W. Broad St., Hazelton, Pa. The invention relates to railway track construction for roadbeds and more particularly to track rails adapted for light-gaged railways or otherwise and to replace the heavy and expensive rolled rails, and the usual toy rails and coupling means, while also permitting and facilitating bending of the rail sections and the retention thereof in any desired angular or bent position.

HIGHWAY FOR GRADE CROSSINGS.—K. W. CARTER, 130 E. Crocket St., San Antonio, Texas. The purpose of the invention is to provide a highway for grade crossings which compels the drivers of vehicles to display the necessary caution when approaching a grade crossing, and permits the clear getaway of the vehicle only after they have actually crossed the rail track, the vehicle being compelled to slow down and to travel in a tortuous roadway before reaching the track.

SAFETY APPARATUS FOR TRAINS OR CARS.—W. O. BATTS, Wilmot, Kan. A purpose of the invention is to provide an apparatus designed to be associated with the wheel trucks of a car and the air brake system, and which operates when the train or car is derailed to effect actuation of the air brakes to stop the train, and which supports the train or car in such manner that the car wheels will be clear of the railway ties to prevent bumping thereon with the attendant destruction or possible overturning of the car.

RAILWAY TIE AND RAIL FASTENER.—C. E. ESTABROOK, Springport, Ind. Among the objects of the invention is to provide a railway tie and fastener of simple, inexpensive and durable construction which is capable of being easily adjusted to support the rails of tracks of different gages, and which is so constructed as to be adaptable to various kinds of ballast, rail, or rolling stock, and which will effectively secure the rails against lateral displacement.

SAFETY DEVICE FOR THROTTLES.—W. W. SYKES, 926 Bainbridge St., South Richmond, Va. The invention relates more particularly to safety device applicable to moving vehicles employing air brakes, the object being the provision of means whereby the operator will be notified when the pressure in the main reservoir of the air brakes falls below the required pressure for proper running. The invention aims to provide means which will positively signal the operator of the locomotive when the vehicle is either in motion or stationary.

VENT VALVE.—J. ULRICH, 1123a So. Taylor Ave., St. Louis, Mo. Among the objects of the invention is to provide an attachment to be applied to the conventional check valve included in the air-brake system of railway engines. The invention is adapted to be associated with the system in such manner that when the check valve is moved against its seat an automatic vent valve is opened and permits the escape of any back pressure which might be built up in the line and prevent the proper releasing of the brakes.

EXTENSION STEP.—A. E. SEIBERT, Frankfort, Mich. An important object is to provide a railway extension step which may be readily and conveniently thrown to its operative position when desired and which when in its inoperative position does not protrude to any objectionable extent. The invention aims also to provide an extension step which is automatically lowered when the trap door of the step is elevated and which may be disconnected from the step when desired.

Pertaining to Recreation

AMUSEMENT APPARATUS.—F. R. CHESTER, 1109 No. Wananassa Ave., Asbury Park, N. J. Among the objects of the invention is to provide an apparatus designed for use in pleasure resorts, fairs, exhibitions and other places of amusement, and arrange to require considerable skill on the part of the player to successfully actuate the apparatus in the shortest time to win the game, and to give each player practically the same chance of winning. The device consists of an apparatus comprising fragile inflatable objects and pressure means for inflating said objects to burst them.

BALL GAME APPARATUS.—W. G. JACKSON, Pompton Lakes, N. J. This invention relates to an apparatus for playing games by the use of balls to be thrown at targets for the scoring of points, and more particularly relates to an apparatus of the indicated character adapted to variously display signals in accordance with the hits made.

Pertaining to Vehicles

MUD GUARD.—F. W. SIMONS, JR., 428 W. 34th St., New York, N. Y. The general object of the invention is to provide a device which may be readily applied to a wheel of an automobile or other vehicle at the outside for preventing the wheel from splashing mud and water on pedestrians or objects at the side. A further object is to provide a device which may be suspended at the side of the wheel and restrained from turning with the wheel.

BRAKE ATTACHMENT FOR AUTOMOBILES.—F. R. PETERSON, 1414 Mallon Ave., Spokane, Wash. The invention has reference more particularly to an attachment to connect the service brake pedal of a Ford automobile with the clutch operating arm of the usual transverse controller shaft, which is usually operated by a hand lever and which also acts to apply the emergency brakes located in the drums of the rear wheels.

REAR-END AUTOMOBILE SIGNAL.—G. G. MOHIN, 74 Hampden St., Holyoke, Mass. This invention has for an object the provision of a construction which will automatically operate when the controlling members of the automobile are operated for producing proper signals at the rear of the automobile according to the particular levers operated, and will present a signal having a legend thereon, a light and a sound.

TRANSMISSION GEARING.—R. D. GEORGE, 4341 Tracy Ave., Kansas City, Missouri. The object of the invention is to provide a transmission gearing especially adapted for use with tractors which provides for an efficient transmission of the motion at all engine speeds, which is of simple and durable construction and which may be easily and readily operated to vary the speed and direction of the transmission of the motion.

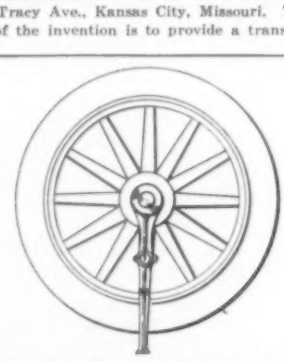


Fig. 9.—An automobile wheel lock which prevents the theft of the car, invented by Rena Lawrence, San Francisco, Calif.

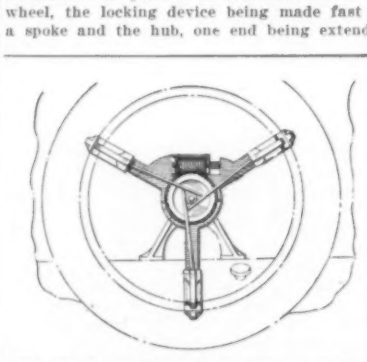


Fig. 10.—A combined tire carrier and rim spreader invented by O. C. Schlenker, of Bovina, Texas

ANTISKIDDING DEVICE.—T. V. ELLIOTT, 312 Denison St., New Brunswick, N. J. The device is intended for use on wheels of automobiles, auto trucks and other vehicles, the object is to permit of conveniently and quickly placing the device in position on the wheel to prevent skidding, or to allow of quick removal whenever it is desired for repair in case of damage. A further object is to provide a device which is durable, and cheap to manufacture.

TOWING DEVICE.—M. T. WATERMAN, 608 Third Avenue, East, Cedar Rapids, Iowa. The invention particularly relates to coupling means for connecting a pair of motorcycles of the side car type, so that a stalled motor car can be readily towed. A further object is to provide a device which can be conveniently carried from place to place, and which will maintain the motorcycles spaced a relative distance apart and efficiently perform its functions whether going up grade or down.

COMBINED TIRE CARRIER AND RIM SPREADER AND CONSTRICTOR.—O. C. SCHLENKER, Bovina, Texas. The purpose of the invention is to provide a device adapted to be attached preferably to the rear of a motor vehicle which is capable of performing the double function of carrying a spare tire and rim and spreading and constricting the rim to effect the application and removal of the tire to or from the rim. (See Fig. 10.)

ATTACHMENT FOR CRANK SHAFTS.—W. W. YARBROUGH, Box 2435 De Soto Station, Memphis, Tenn. The object of the invention is to provide an attachment of the character specified adapted for use with the crank shafts of motor vehicles for receiving end thrusts and for removing the strain from the main bearing produced by the clutch spring, to retain the magnetos in good order and to obviate the necessity of spinning the crank to start the motor.

ILLUMINATED SIGN.—J. H. KELLY, 5014 Feret St., New Orleans, La. The purpose of the invention is to provide a sign particularly adapted, although not necessarily, for use on motor vehicles and in such manner as to be prominently displayed and illuminated by lamps which are connected to the lighting circuit of the vehicle. A further purpose is to provide a simple and inexpensive construction with means for detachably supporting the same.

STEERING WHEEL LOCK.—R. T. BINDER, 231 Halsey Street, Newark, N. J. The inventor has been granted two patents of a similar nature, their object being to provide a steering wheel lock which will enable the user to lock the steering wheel against rotation and against removal, and make it practically impossible for unauthorized persons to free the locked parts, the locking parts being so concealed as to prevent their mutilation.

MOTOR VEHICLE.—E. B. JACKSON, 30 East Jackson Street, Wilkes-Barre, Pa. The invention has for its object to provide a vehicle wherein the two wheels which support the vehicle are in line in the same manner as a bicycle, with an enclosed body on the lines of an automobile, and wherein means are provided for steering the vehicle and controlling the motor operable from the seat in the body, and means for supporting the body in upright position when not in motion or moving slowly.

WHEEL LOCK.—RENA S. LAWRENCE, 1087 Market St., San Francisco, Cal. The primary object of the invention is to provide an automobile wheel lock which will prevent unauthorized removal of the wheel and also act as an obstruction to prevent normal rotation of the wheel, the locking device being made fast to a spoke and the hub, one end being extended beyond the rim whereby readily traceable marks will be made in the road accompanied by a noticeable "bumping noise" as the car travels. (See Fig. 9.)

SHOCK ABSORBER.—P. F. HALFERTY, Aberdeen, Wash. The invention relates more particularly to shock absorbers of the snubber type for use on automobiles and other similar vehicles, an object being to provide means for utilizing air pressure or partial vacuum and also spring pressure to absorb shocks and jars. The device is relatively small and can be conveniently attached to the frame or chassis of an automobile.

STAKE.—E. OLSON, 111 2nd Ave., So., Great Falls, Mont. An object of the invention is to provide a wagon body stake which carries a spring actuated locking means for automatically locking the stake in a pocket, thus obviating the very common inconvenience caused by the stake jolting out when traveling over rough roads. A further object is to provide a self-locking stake which will be strong and durable, and comparatively inexpensive to manufacture.

BICYCLE STAND OR SUPPORT.—A. DONATI, 391 Gold St., Brooklyn, N. Y. The primary object of the invention is to provide a stand for bicycles, motorcycles and the like which is automatically held or retained in its inoperative position. A further object is to provide a device which when in its operative position will automatically move to the inoperative position when the weight thereon is relieved. The device may be attached without change to bicycles or motorcycles of standard designs.

TIRE PUMP.—F. HJORTH, R.F.D. No. 2, Harlan, Iowa. This invention relates particularly, although not necessarily, to hand-operated tire pumps, a purpose being the provision of an air pump in which the intake and expulsion of air occurs at each stroke of the piston, whereby the pumping capacity of the pump is doubled as compared to that of the ordinary pump.

APPARATUS FOR THROWING THE WHEELS INTO AND OUT OF ACTION OF A VEHICLE, HAVING BOTH WHEELS AND ENDLESS TRACKS.—E. RIMAILHO, 12 Rue de la Rochefoucauld, Paris, France. The invention provides a construction of apparatus in an automobile or other vehicle, having wheels and endless tracks and capable of drawing directly or by towage, or of carrying a load over any kind of ground, whereby either of these two methods of progression may be brought into use at will, one being suitable for roads and permitting of rapid speed, the other being suitable for various kinds of ground to be traversed away from roads.

CLASP.—O. GEHRKE, Meyers Falls, Wash.—The invention relates to a fastening element in the nature of a clasp, which is primarily adapted for use in connection with anti-skid chains, and by means of which an element will be provided which will permit of an instantaneous association of the anti-skid member with the wheel, and prevent any accidental detachment thereof, although permitting of its being wilfully accomplished.

JACK.—H. A. THORNDIKE, 205 No. Main St., Orlando, Fla. The object of this invention is to provide a device of the character specified, especially adapted for use with motor vehicles, and to be attached permanently in place on the axles, and to be normally out of operative position, but capable of being brought into operation when desired, merely by the movement of the jack in its normal operation.

RESILIENT WHEEL.—A. NIN Y MARTINEZ, P. O. Box 665, San Juan, Porto Rico. An object of this invention is to provide a construction wherein resiliency is secured through the use of compressed air operating at the end of reciprocating spokes. Another object is to provide a comparatively stiff rim having hinged spokes and means associated with the hub which will take up the shocks and resiliently limit the swinging movement of the spokes and the movement of the rim.

AUTO TREADMILL.—C. E. ANDERSON, 514 2nd Ave., Superior, Wis. Among the objects of the invention is to provide a treadmill on which an automobile can be conveniently run so as to position the drive wheels in frictional engagement with pulleys for generating power which may be utilized for any desired purpose. A further object is to provide a device which can be readily moved from place to place.

Designs

DESIGN FOR A COLLAR FASTENER.—S. L. GEDNEY, 33 Clinton Ave., Maplewood, N. J.

DESIGN FOR A SIFTER TOP RECEPTACLE.—M. WOLF, 1186 Trenton Ave., Bronx, New York.

DESIGN FOR A LAMP.—C. W. LA ROCHE, 2432 W. York St., Philadelphia, Pa.

DESIGN FOR A HANDLE.—P. M. MARKO, 1402 Atlantic Ave., Brooklyn, N. Y.

DESIGN FOR LACE.—H. BINCH, 102 5th Ave., New York, N. Y.

DESIGN FOR AN UMBRELLA AND PARASOL TIP.—B. O. WRIGHT, 91 Fifth Ave., New York, N. Y.

DESIGN FOR A PIN.—M. MANFREDY, 1359 Forty-third Street, Brooklyn, N. Y.

DESIGN FOR A STORAGE BATTERY TERMINAL.—P. M. MARKO, 1402 Atlantic Avenue, Brooklyn, N. Y.

DESIGN FOR A STAND.—J. D. HOLMES, 315 Fourth Avenue, New York, N. Y.

DESIGN FOR A HANDKERCHIEF.—C. L. SUMNER, care The William Sumner Co., 926 Broadway, Tacoma, Wash.

DESIGN FOR A BAG FRAME.—E. NORMAN, 386 East 139th Street, Bronx, N. Y.

DESIGN FOR AN ELECTRIC IRON.—A. RUELLAND, 63 E. 79th St., New York, N. Y.

DESIGN FOR A ROSARY.—G. THIBAULT, Whitehall, N. Y.

DESIGN FOR A REFLECTOR.—E. ZIMMERMANN, JR., P. O. Box 142, Hudson Heights, N. J.

We wish to call attention to the fact that we are in a position to render competent services in every branch of patent or trade-mark work. Our staff is composed of mechanical, electrical and chemical experts, thoroughly trained to prepare and prosecute all patent applications, irrespective of the complex nature of the subject-matter involved, or of the specialized, technical or scientific knowledge required therefor.

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Miscellaneous Notes

Baby Travels by Air.—The first baby in arms to patronize the Continental airways left the London Air Station for Paris on the 12.30 airplane express recently.

New French Coins.—Bronzed aluminum coins to the value of 20,000,000 francs are being distributed by the Bank of France to replace paper money condemned as unsanitary.

For the Lazy Bather.—A novel sea-bathing accessory is in the form of an easy chair made of the cork-like balsa wood, in which the bather lounges half-submerged while reading, smoking or chatting.

Light, Airy Blocks.—Instead of building in city-block style, a contractor is turning each house at an angle of 45 degrees, giving the block a saw-tooth façade and admitting light and air from four directions.

Human Flies in Rome.—Our students at the American Academy are scaling the Trajan Column and crawling over the rotunda of the Pantheon; they are studying, measuring and drawing the details of these masterpieces.

Reconstruction's Progress.—Ninety per cent of the devastated area in France is now restored to cultivation; half the destroyed manufactories have been reopened, and 99 per cent of the damaged railway lines are again in use.

Dogs and Horses as Food.—In the second quarter of 1919, the meat of 3642 dogs was passed upon by inspectors of the German imperial slaughter houses; horse meat also was in great demand, and the number of horses slaughtered for food was double that of peace time.

British Competition in Bolivia is placing American goods at a great disadvantage. A British company is missionizing the country in favor of English-made goods, and is forcing customers to buy any American goods through Liverpool, thus doubling the freight.

President Harding's Finger Prints.—Delegates of the International Association for Identification, recently convening at Washington, persuaded President Harding to be finger-printed for their records. The Association seeks the registration of all Americans, the records to be kept at post offices.

Swiss Watches Not Wanted.—Largely because Americans are now buying their native product, the Swiss watchmaking industry is in the doldrums, and has despairingly appealed to the government for a subsidy; 32,000 watchmakers are idle in spite of the fact that watches are being offered at practically cost price.

Rubber Production Falls.—In parts of Brazil plantations have been abandoned and rubber manufacture reduced almost to zero. Some of the rubber land is being planted to cotton, a little is being worked barely enough to keep paths open between the trees; it means practically no rubber from this territory for the fiscal year ending April, 1922.

Meteors and Forest Fires.—France has been suffering from forest fires of mysterious origin; the careless cigarette smoker has been blamed, but foresters and some meteorologists now incline to the belief that falling meteors were the cause. In one flame-swept area of a thousand acres were found great meteoric fragments, still hot three days after the fire.

Two Wonderful Books.—The casual observer might see nothing especially remarkable in two books exhibited by the Smithsonian Institution; yet they are unique in that they were written and made by one man, the late Dard Hunter, of Chillicothe, Ohio. He manufactured the paper, designed and cast the type, set it up, printed the volumes on a hand press, and bound them himself.

Watches with Two Hour-Hands.—The latest fad is the timepiece with two hour-hands. The commuters started it, that they might have railroad time and daylight saving time before them at a glance; but the girls with lovers in foreign parts are calling for watches that enable them to visualise what "he" is doing in London or elsewhere. One such call was for a watch showing the time here and in Shanghai.

Why Germany Can Undersell Us.—Using the mark as a basis of comparison, of 2,300,000 German metal workers 63 per cent receive 8 times the wages of 1914, 36 per cent from 5 to 8 times as much, and the rest less than 5 times the 1914 wages. Since, in the same time, the cost of living has increased 15 times, the actual wages are but from one-third to one-half those of 1914. No wonder German manufacturers can undersell the world.

Farming in China.—For 4000 years Chinese methods have maintained the fertility of the soil. Despite obsolete equipment, China is probably, after the United States, the foremost agricultural nation; intensive cultivation grows several crops on the same plot of ground. The farmer generally owns his land, though the average farm is but an acre in extent. No less than 80 per cent of the foreign trade consists of agricultural and allied products.

Germany's Book Output.—The German literary mill ground out 32,345 books in 1920, an increase of 6151 over 1919. Political economy fell off from 3400 to 3200; art, music and the theater from 589 to 495; and military science from 243 to 176. Increases appear under theology, 1847 to 2302; philosophy, 654 to 950; medicine, 1072 to 1439; pedagogy, 2600 to 3149; literature and linguistics, 1654 to 1726; history, 966 to 1300; trade, 1499 to 2075; juvenilia, 1016 to 1451. In giving these figures, the *New York Evening Post* expresses thankfulness that the increase in *belles-lettres* has not been large!

The difficulty of many a task is largely determined by the fitness of the tools with which the worker is equipped.

On this job, for example, the Starrett Universal Dial Test Indicator used with a Starrett Vernier Height Gage is enabling the machinist to quickly and easily set his boring bar for this exacting job. Without precision tools such as these, metal working operations within close limits could only be accomplished slowly, laboriously and inaccurately, if at all.

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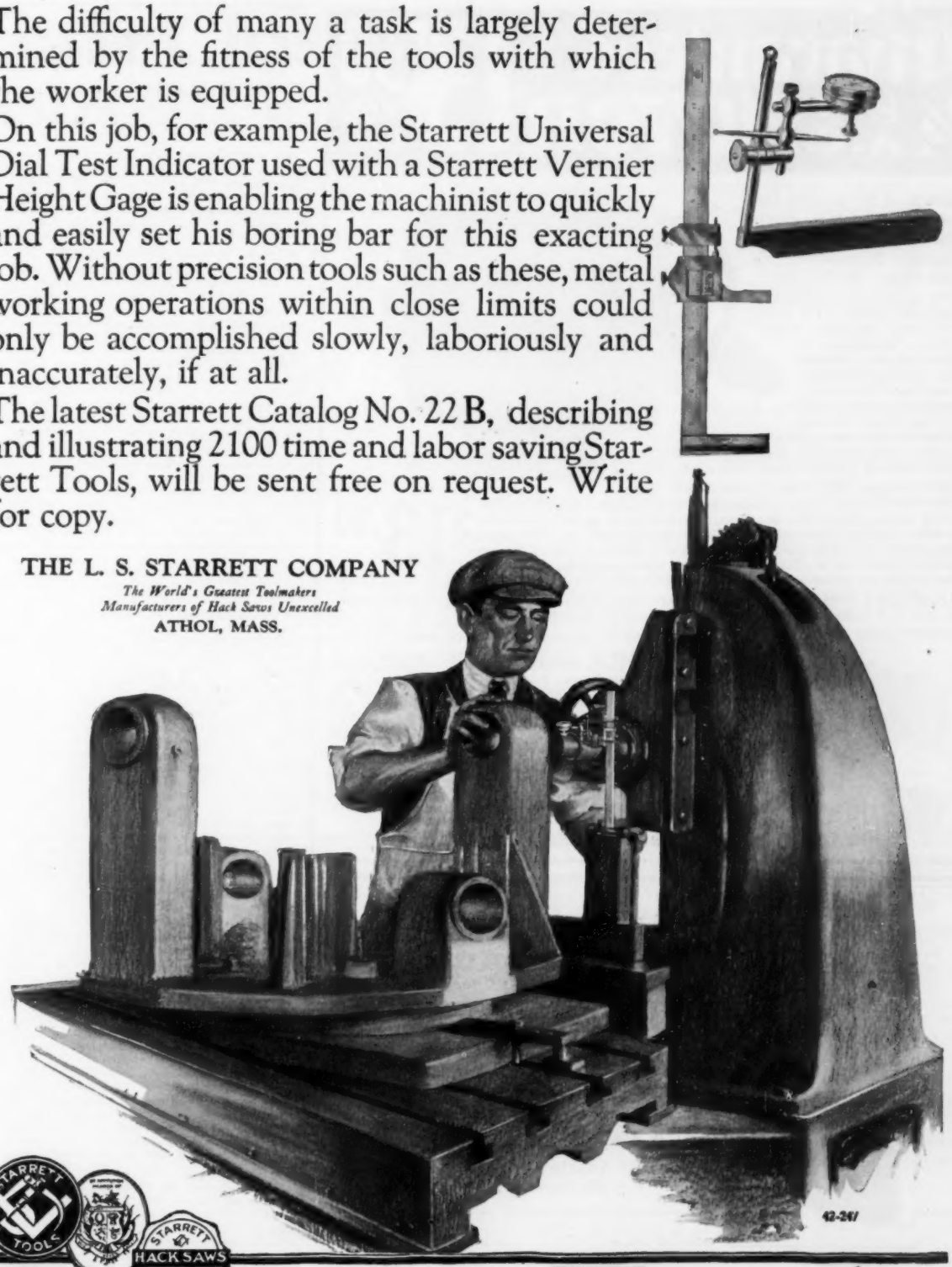

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Made of light or heavy spring-tempered steel, flexible and semi-flexible, graduated in the English or Metric systems.

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Starrett Spacing Attachment for Center Punches

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Electrical Notes

Summaries and Excerpts from Current Periodicals

New York's Water Power Bill became law when Governor Miller of New York signed the Gibbs Water Power Bill, providing for the licensing of the undeveloped water power of the State to private interests, under the supervision of the State. The measure was introduced in the Legislature by Senator Leonard W. M. Gibbs of Buffalo.

A New Direction Finder.—According to the *Electrical World*, a new method of finding direction has been developed by the engineers of the Marconi company. The advantage claimed for this new method is that it is less seriously affected by the reflection and refraction phenomena which are usually known as night effect. The system consists of the well-known combination of the Bellini-Tosi aerial and an open aerial adjusted to give a heart-shaped diagram with a single zero. It is indicated that a receiver of this type may give very inaccurate results, but if the signals are so strong that the minimum is sharply defined there should be no difficulty.

A High-Voltage Fuse.—The problem of fusing a high-voltage circuit is a difficult one to solve, for the reason that after the fuse blows through one cause or another, the arc formed must be immediately extinguished to break the circuit. A recently-introduced high-voltage fuse consists of a fusible element held in tension by a spiral spring within a glass tube, which is filled with a non-inflammable liquid of extremely high dielectric strength. This liquid will not freeze in any climate, the freezing point being lower than 65 deg. below zero F. A current greater than the fusing value of the fuse results in the melting of the fusible element, instantaneously releasing the spring which establishes a definite large gap. This clearing of the circuit requires less than one cycle.

The Toggle Switch.—The toggle or tumble switch, long a favorite in Europe, is slowly making its way into the best American homes, due to three reasons: (1) Handsome appearance; (2) simplicity of installation and operation; (3) the fact that once installed they remain permanently fixed in position and require no further attention. To introduce the toggle switch in this country, radical changes over the European type of mechanism were necessary. An instantaneous make and break had to be substituted for the slow make and break used abroad. A flip of the fingers or a movement of the elbow is all that is required to operate the toggle switch. One American manufacturer has provided his toggle switches with a luminous tip, so that they may be located in the dark.

Why Use the Arc System?—For unfailing regular communication by radio over long distances the arc system should be employed, so we are informed by followers of this method of radio transmission. Generating continuous waves, the arc system has all the advantages of: Maximum power input to a given aerial system due to uniform electrical strains on the insulators, enabling a cheaper and smaller aerial system to be employed to transmit over a given distance, or increase of range of an existing station by substitution in place of a damped wave generator. Greater selectivity in reception with consequent greater freedom from jamming and atmospheric disturbances, thus rendering the service less liable to interruption. Heterodyne reception, giving improved signal strength and choice of audio-frequency to suit the operator with still further freedom from interruption.

Development of the Flashlight Battery.—In a recent paper dealing with flashlights and flashlight batteries, prepared by E. H. Mathews, we learn that the flashlight was invented in 1898 by David Misell, who also developed the first flashlight battery. Great difficulty was experienced in marketing the early batteries due to their short life and lack of facilities and the unwillingness of lamp manufacturers to make miniature lamps with carbon filament taking 4 watts per horizontal candlepower. The efficiency has been increased far beyond the expectations of the pioneers in flashlight manufacture. Over 580 patents have been allowed covering flashlights, hand lamps, and combinations involving flashlights. During the past year the business totalled $20,000,000. It is estimated that there are over 10,000,000 active users of flashlights in the United States, and that over 5,000,000 are sold annually. Over 25,000,000 batteries are manufactured yearly for use in these flashlights.

Reversible Electric Valve Tube.—For some purposes where one-way electric valve tubes are used it would be desirable to reverse their valve action without any change in electric connections, we gather from *Elektrotechnische Zeitschrift*. This has been made possible by a new valve tube designed by H. Greinacher of Germany. The tube consists of a spherical glass bulb with two cylindrical ends, containing each a short leading-in wire. Between the two cylindrical ends an aluminum tube, insulated from the two electrodes, is stretched. Within this metal tube is a small aluminum ball. If this apparatus is tilted to the left side, the ball rolls down to the left and makes contact between the left leading-in wire and the tube, so that in this position the left electrode is large and cylindrical and the right electrode just a short piece of wire, resulting in a certain valve action. A slight tilt in the opposite direction makes the ball roll over to the other side, when the characteristic and valve of the tube will be reversed.

The Weston Standard Cell.—Invented by Edward Weston, Ph.D., LL.D., and first marketed in 1892, the Weston Standard Cell rapidly supplanted the Clark and other preceding cells prepared for standardization purposes. For 29 years it has been considered the standard cell because of its constancy of voltage, negligible temperature coefficient error and its portability. The Weston cell is made in two forms: (1) The Weston Normal Cell, which is a saturated form which has been adopted by the National Standardization Bureaus of the world as the standard of electromotive force. (2) The Weston Standard Coil (unsaturated form), which is recommended by National Bureaus of Standards as a practical standard because it has no appreciable errors due to temperature changes, whereas the normal cell or saturated form has a temperature coefficient which, though much less than that of any preceding form of cell, must nevertheless be taken into consideration.

The Negatron is a new form of vacuum tube which has made its appearance in England. The principle on which this device works is briefly as follows: A thermionic valve is arranged with two flat anodes, one on each side of a filament, according to *The Electrician*. Each anode is connected through an anode battery to the filament so that the electrons emitted by the incandescent filament are distributed equally between the two anodes. A control electrode, *e.g.*, a flat grid, is also arranged within the valve between the filament and one of the anodes. This latter anode is called the diversion anode, while the first one is called the main anode. By suitably arranging the relationship between the electron emission and the anode voltages we may obtain a saturation effect. When the main anode voltage is increased the grid potential is increased, electrons are diverted from the main anode and the main anode current decreases. Hence the negative resistance effect. The main use of the negatron is as a generator of continuous oscillations for the transmission or reception of continuous waves.

Radio Central Progress.—By the time this is read the Radio Central wireless station at Rocky Point, Long Island, N. Y., some 50 miles east of New York City, will probably be in operation. At the present writing, the latter part of November, news comes to us that two of the wings or spokes of the wheel-like arrangement of the antenna towers have been completed. Twelve steel towers, each 400 feet high, compose the two wings or one operating unit. The total distance between the first and the twelfth towers of the complete unit is approximately 3 miles. In the center of these twelve towers is the central power-house, which is now completed, and two of the 200-kw. Alexanderson high-frequency alternators have been installed and are ready for operation. The receiving station designed to operate in connection with the Radio Central is at Riverhead, L. I., about 17 miles away. This receiving center is capable of intercepting six different messages simultaneously. The control system is so arranged that there are no actual receiving operators present. The aerials pick up the signals, special apparatus in turn direct these to a regular land line, and finally the messages are received in New York City. A complete description, together with a collection of photographs of the Radio Central station, appears on page 8 in the present issue of this journal.

Signalling by Invisible Rays.—Many months before the United States entered the war Dr. Louis Bell and Norman Marshall of Boston attacked the problem of evolving a suitable invisible ray signalling system. From a recent issue of *Electrical World* we learn that they met with success in utilizing ultra-violet rays and that their system was actually tried out at the front. In the past there have been several attempts to signal by rays normally invisible, but all previous efforts had been either with the extreme ultra-violet, using the carbon or mercury arc or even sparks between metallic electrodes as a source, or else they had drifted toward the infra-red in the belief that the ultra-violet was so quickly absorbed by the atmosphere and so difficult to obtain in quantity as to be impracticable for portable service, and even less attainable in suitable transmitting apparatus. As far as Messrs. Bell and Marshall could ascertain, every previous effort to utilize the ultra-violet had employed quartz apparatus, this, of course, being utterly impracticable for production in quantity as required for military use. These inventors at the outset abandoned the traditional ultra-violet, which has been persistently championed in some academic circles. They turned to the region just beyond the visible spectrum, hitherto neglected, and immediate and striking success resulted. The screen to cut off the visible spectrum was finally evolved by a combination of glasses produced by Dr. H. P. Gage of Corning, N. Y. For receiving purposes, a pair of field glasses is employed, provided with a barium-platinum-cyanide fluorescent screen mounted near one eyepiece. In practice the distance between the transmitter and receiving apparatus ranges from a few feet to 6 miles or more.

Book Reviews

MANUFACTURING INDUSTRIES IN AMERICA. Fundamental Economic Factors. By Malcolm Keir, A.M., Ph.D. New York: The Ronald Press Company, 1920. 8vo.; 324 pp.

Men of business and students of economics will have noticed the recent increase of works on our industries, unfortunately these are for the most part written either in highly technical language or in journalese; Professor Keir's volume avoids both extremes, addressing itself directly to a practical clientele. Thoroughly to know your own industry, you must know also those industries that supply it and make its existence and success possible. Among more general material, the chapters treat of steel, cotton, wool, leather, shoes and paper, and consider some effects and tendencies of our manufacturing practice.

SMALL MOTORS, TRANSFORMERS, ELECTROMAGNETS. By H. M. Stoller, B.E., M.S., F. E. Austin, B.S., E.E., and E. W. Seeger, M.E. Chicago: American Technical Society, 1921. 8vo.; 320 pp.; illustrated.

By cutting theory to bare essentials, the authors compress into one simply worded handbook three subjects of interest to engineer and amateur. The latest and best practice in the design of small motors is described with careful attention to detail, and many types up to ½ horsepower are offered, including a starting motor and a charging generator for automobiles. The book also conveys accurate knowledge of the low-tension transformer, from 110 to 220 and down to the lower voltages, and of the construction of transformers suitable for wireless. The work concludes with typical designs of electromagnets, carrying calculations through to final results; the material on induction coils includes a concise description of the Tesla coil.

LESSONS IN MECHANICS. By William S. Franklin and Barry MacNutt. Bethlehem, Penn.: Franklin and Charles, 1919. 8vo.; 221 pp.; illustrated.

This text is arranged to meet the needs of the two-year schedule in elementary physics recently adopted by some technical schools, and emphasis is placed upon "the mathematical bottom of the subject." Hence differential and integral calculus appear, though previous study of calculus is not demanded. The course brings mathematical and physical elements into close coöperation, facilitates classroom work, and leads each topic into illustrative problems.

THE ENGINEERING DRAUGHTSMAN. By E. Rowarth, A.M.I.E.E. New York: E. P. Dutton and Company. 8vo.; 245 pp.; 96 plates.

Many branches of engineering are represented in this course for students already in touch with elementary principles. Its method of instruction is by illustrative plates of machines, augmented by a full, clear explanatory text. Frequently, sufficient information is supplied to enable the student to finish sets of working drawings covering such machines as the steam hammer, single ram pump, hydraulic press, oil pump, steam engine governor, and lathe. Altogether there are more than 150 examples interestingly and lucidly presented; with tables of threads, keys, and decimal and metrical equivalents.

AN INTRODUCTION TO SCIENCE. By Bertha M. Clark, Ph.D. New York: American Book Company. 8vo.; 494 pp.; illustrated.

LABORATORY MANUAL FOR INTRODUCTION TO SCIENCE. By Bertha M. Clark, Ph.D. New York: American Book Company. 8vo.; loose-leaf, 203 pp.; illustrated.

This introductory text and laboratory manual have been in use for several years and have proved successful in their aim of beneficially interesting young high school students in their present, as well as better fitting them for the future. The scientific projects include dietary standards, fuels, lighting, labor-saving devices and hygienic facts.

A TREATISE ON REINFORCED CONCRETE. By W. Noble Twelvetrees, M.I.Mech.E., etc. New York: Isaac Pitman and Sons, 1920. 8vo.; 264 pp.; illustrated.

From a vast field the author has selected such material as best discloses the characteristics and properties of reinforced concrete and its constituents, the principles underlying the design of homogeneous members, and the application of these principles to the evolution of formulæ. The work has distinct claims upon attention; one, in being the first work in English to use the Standard Notation of the Concrete Institute; another, in its surprisingly complete set of formulæ for the resistance moments of reinforced concrete beams.

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Science Notes

A Digest of Everything of General Interest Appearing in Current Literature

The Saber-toothed Tiger, according to recent evidence, roamed the earth 200,000 years ago.

Scientific Congress.—The third Pan-American Scientific Congress will be held in Lima during July, 1923.

The Weevil and the Market.—The recent rise in the price of cotton has been directly traced to the ravages of the boll-weevil, which caused a shortage in the crops.

A Hardy Alligator Pear.—A hardy variety of avocado has been found in Ecuador; the fruit weighs as much as 18 ounces, and the tree will stand some frost.

Doubling the Life of Plants.—A Viennese botanist has been able to double the length of life in certain annuals by suppressing their blossoms. This was done by withholding moisture, oxygen and other necessary substances.

Peru Protects Her Relics.—Except by permission of the Peruvian government it is forbidden to disturb or export archaeological relics, instruments, mummies, or other remains of the ancient Inca and pre-Inca civilizations.

Bamboo.—It is now proposed to import bamboo from Chile, and establish this plant in California. The South American self-propagating species thrives equally as well in the drier, as the more humid, climates. It is an excellent cattle-food.

The Secret of Eskimo Health.—The Eskimos are naturally one of the healthiest peoples in the world; why this should be so is not as yet apparent. The School of Hygiene of the Johns Hopkins University will send out an expedition next May to study dietetics and nutrition among the Eskimos.

A Monument to James Orton, the American explorer, has been erected on Esteves Island, Lake Titicaca, where he was buried, by a Vassar College alumnae committee. Orton was professor of natural history in Vassar in 1869, and led several Amazon expeditions.

The Tsetse Fly and Big Game.—An investigation is under way in Rhodesia to determine the source of infection carried by the tsetse fly, which causes sleeping sickness. It is now suspected that the primary host of the blood parasite, known as a trypanosoma, is to be found among the herds of wild antelopes and other big game.

The "Laurentic" and Her Gold.—The *Laurentic*, sunk off Lough Swilly in 1917, went down with $20,000,000 in gold bullion, about half of which has been recovered. She lies at a depth that makes diving operations extremely difficult, and a diver likens her appearance to that of a long street of houses which has collapsed in the middle.

The Pitcher Plant.—It has been found that the digestive agency of the insect-eating plant, *Nepenthes*, is sterile when taken aseptically from the unopened pitcher. But, according to Nature, it becomes more effective after exposure to bacterial invasion. This septic condition, together with the enzymes contained in the bodies of the captured insects, are presumed to cause digestion.

Our Paper Mill in Siam.—A duplicate of the experimental paper plant with which the Bureau of Standards successfully produced paper from rice straw, banana tree stems and lalang grass was ordered by the Siamese government, and is now on its way. It has a capacity of 1200 pounds a day, and will be used to supply the Siamese army with writing and printing paper.

City of London Is Just a Mart.—The City of London (proper), bounded by municipal and parliamentary lines, is not a dwelling-place, but a vast market. In 1896 it had 31,000 inhabitants; to-day it has but 13,706. During business hours it is the humming hive of a million human bees, but night finds it deserted save for a garrison of caretakers.

Wild Life Investigations.—The Roosevelt Wild Life Forest Experiment Station at Syracuse, established by New York State as a memorial to Theodore Roosevelt, is pursuing field investigations in the 7000-acre Allegheny State Park, south of Buffalo. Birds and fishes are being studied there, and funds have been provided to remedy the present rather precarious status of the beaver in the Adirondacks. A field party is also in the Yellowstone studying wild-life problems.

War Declared on the Rat.—In the hope of materially reducing our annual loss of $200,000,000 due to the depredations of rats, the Biological Survey is starting a great campaign in the eastern States and is asking the hearty cooperation of every householder. We have already called attention to a similar campaign in the West, where convict labor was used in distributing poisoned bait over the fields; one farm that had to replant twice last year has this year a fine, promising stand of corn from one planting.

The Cause of Goitre.—Sodium iodide has been administered as a prophylactic in goitre with marked results. E. R. Hayhurst of the Ohio State Department of Health believes that lack of iodine in the body is a cause of goitre, and he warns us against the commercial practice of eliminating iodine from table salt. Although goitre is prevalent in salt-mine districts it is probable that time has materially changed the composition of these deposits, and as sodium iodide is freely soluble, it would be the first of the halogen compounds to disappear.

The First Medical School.—According to Greek legend, the founder of the first medical school was Chiron, the centaur. Aesculapius was the only one of his many pupils that equalled the master. He studied the curative properties of plants and the treatment of diseases and wounds. If we can believe Homer, the two sons of Aesculapius, Machaon and Podalyre, organized the first army medical corps, which functioned during the siege of Troy. Greece made demi-gods of her scientists and doctors, and the Iliad remarks that a physician "is worth many men."

In Gorilla-Land.—Carl Akeley, sculptor and explorer, is now in the Belgian Congo to study the gorilla at close range. The women of the party will each carry a camera and a small Winchester. Mr. Akeley was with Roosevelt in the African expedition of 1911. He hopes to obtain some worth-while scientific results for the American Museum of Natural History, to accumulate a series of striking photographs, and, luck being with him, to bring back a gorilla family. Asked about trouble with natives, he declared savage man was much less terrifying than the civilized product.

St. Paul's Whispering Gallery.—Lord Rayleigh explained this phenomenon by the curvilinear propagation of sound; that is, the tendency of the waves to cling to the wall-surface of the dome and creep tangentially along it. Recent investigations seem to show that he was right in assuming that the waves travel in a comparatively narrow belt skirting the wall, the thickness of the belt decreasing with the wave-length, but that he was mistaken in holding that in this belt the intensity is maximum near the wall and decreases rapidly on receding from it. The experiments located alternate zones of intensity and comparative silence between the sound-source near the wall and the center of the dome space.

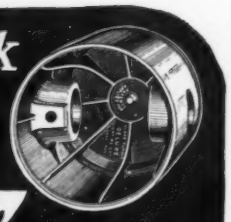
Excavations in Ascalon, which have already disclosed Herod's famous cloisters and a statue of the great ruler himself, may eventually clear up many of the ethnical, geographical and theological mysteries that cluster about the site. Ascalon, one of the five great cities of the Philistines, takes us back to the 15th century B. C., and discoveries have already yielded evidence of three prime civilizations, the Philistine, the Roman, and the Crusading. The Philistine culture presents alluring and baffling aspects; whence it came, whither it went, are questions awaiting more light. Fertile Ascalon is being buried by the sands of the sea; unless this encroachment can be arrested the place will become a desert. Meanwhile further disclosures are awaited with tense interest.

Sensitiveness in the Sensitive Plant.—According to the Journal of the Botanical Laboratory of Pennsylvania, the propagation of stimuli in *Mimosa pudica* and *Biophytum sensitivum* is centered in the endodermis. It is stated that the concentration of oxylate of lime in these tissues is supposed to be associated with the phenomenon of sensitiveness, and that the sensibility of the plants was proportionate to the amount of crystals contained in the cells. Each crystal was found to be contained in an envelope of protoplasm, which latter were connected throughout the cells by threads of protoplasmic matter. The analogy of these conductors for the transmission of stimuli, to the nervous system of animals, is interesting in view of recent theories which propose that plants have the germs of mind.

Psycho-Analyzing Alice.—Andre Tridon, who is the extension of Freud's shadow over America, has been saying a few words about Alice, of Alice-in-Wonderland fame. Alice, it seems, has grossly deceived us; she is, as her creator was, a dangerous paranoiac, and should not be allowed to play with nice little children. Tridon gives overwhelming arguments in proof of these assertions, their only weakness being that they apply with equal force to psychoanalysts themselves, and he leaves us with the impression that Lewis Carroll should have been placed in an asylum and deprived of pen and ink. The creator of Alice has passed on, but the Ouija board is very much with us; it would be delightful to have Lewis Carroll's candid opinion of the Wonderland created by Freud and Tridon.

Giants.—From Nature we learn of a recent meeting of the British Association, wherein it was brought out that the popular conception is untrue regarding power of giants and the magnificent types of masculinity which they are supposed to be. Statistics were presented to show that giants were relatively feeble, usually short lived, and, in the majority of cases, devoid of those features peculiar to masculinity. Gigantism was said to be identified with abnormal conditions of two small organs located at the base of the brain—the thyroid gland and the pituitary body. The over-activity of these, preceding or near the period of birth, is the primary cause. Sometimes, however, their over-activity comes into play after the individual has attained his full growth, and, as a result, an overgrowth of the extremities takes place.

Look into this



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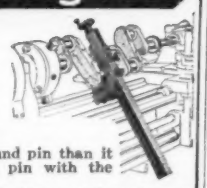

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Pulley Analysis.—The manufacturer of a leading paper pulley is advertising the results of a recent engineering test made of three different pulleys: paper, cast-iron, and wood. At 2 per cent belt slippage, which was assumed to be the normal condition, it was found that the paper pulley had 2½ times the transmitting capacity of the iron one. The advantage fell off at greater belt slips, as might be anticipated. In these tests the wood pulley showed up slightly better than the metal one.

Perforated Tape Control for Machinery.—A recent writer in *American Machinist*, with the success of two such diverse bits of apparatus as the player piano and the monotype before him, makes the suggestion that this principle is deserving of an effort to extend it more generally into machinery practice. He thinks that automatic lathes of all descriptions a particularly promising field for the innovation, and points out that theoretically at least there is not the slightest limit to what the tape can constrain the machine to do.

The Deterioration of Rope used for power transmission is held to a minimum when the sheaves over which the line runs have a pulley diameter equal to at least 40 times the diameter of the rope for speeds of 4500 running feet per minute, or of 27 times the rope diameter for speeds around 3000 feet. A 45-degree-angled V-shaped groove is recommended as the best compromise between a shallow groove, which results in slippage and excessive wear, and a very steep groove, which grips the rope too well, and on this account uses additional power because of the tendency for the rope to stick.

Valve Grinding on any sort of internal combustion engine would be robbed of its terrors by general adaptation to general use of a grinding outfit now made mostly, if not altogether, for use with the popular small automobile. A spindle fits into the hole on each valve tappet, and these are all connected with a single operating handle. The operator works this handle back and forth in a horizontal plane, and the motion is communicated to the valve tappets as a rotary one. When one valve is finished before the others it is removed entirely and the machine goes on with the remaining ones.

Lumber Waste for Fuel.—"Hog fuel," consisting of sawdust, shavings, ground-up edgings, slabs and trimmings, etc., is widely used throughout the northwestern lumber fields, but only as an incidental; and the disposal of this material is usually a charge against the mill. A central heating plant has now been erected in Tacoma, designed especially for the burning of this fuel and with no provision for handling any other. The ultimate capacity will be taken care of by four vertical water-tube boilers of 7500 square feet each. The fuel arrives on barges and is handled by a 5-ton clamshell bucket and a system of conveyors. Full details of this interesting installation appear in *Power* due November 15th.

Powdered Coal Preparing Machines are nothing new, but one recently put out is perhaps rather novel in the manner in which it combines impact pulverization with air separation. The pulverized material is discharged by centrifugal force directly into a large separating chamber. An exhaust fan, in the discharge duct leading from the separating chamber, draws air at slow velocity through this chamber, removing the fine coal and allowing the oversize to return to the machine for further pulverization. Adjustment as desired is possible by virtue of the fact that the air velocity through the chamber determines the line of fineness between the delivered product and that which goes back to the hammers.

Edison's Snow Remover.—Winter brings back the old problem of snow removal, and at a forum on "Snow Removal in Cities," held in the Engineering Societies Building, it was pointed out that Edison turned his attention to this question 40 years ago. At that time he built a big truck carrying a steam engine and compressor; this, going as fast as a horse could walk, gathered the snow up in front, passed it into the compressor, and left it in its wake in the form of little blocks of ice taking up but one-tenth the room of the snow. While success attended his efforts, the undertaking was dropped in favor of other inventions. Mr. Edison can not recall the horsepower of the engine or the size of the compressor, but believes that a larger compressor would have given even better results.

Oil Coolers on Marine Turbines.—In the lubricating systems of small units, filters not being used, remarks *The Practical Engineer*, it is important that means be provided for returning the circulating oil to the bearings at the appropriate temperatures. Passing the oil through a coiled tube contained within the sump tank has certain definite disadvantages. By far a better method is to provide a separate oil-cooling tank. This should be constructed like a steam condenser, but with baffle plates to break up the oil stream and provide a more effective and extensive cooling surface. The water circulation through the oil cooler should be by pump and not by gravity or thermo-siphon, and the water pressure should always be less than that of the oil, so that in the event of an internal leak the oil will merely escape, rather than being diluted with water.

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Patents and Trade-Marks

General Principles, Current Comment, and Interesting Decisions

Trade-Marks Under the International Bureau.—Claims must be submitted to Habana through the U. S. Patent Office. The applicant provides the Office with a fee of $5 in lieu of an abstract of title; the Bureau's fee of $50 in international money-order form; an electrotype not exceeding 10 centimeters in either direction, with 30 reproductions in color if color is a distinctive element; a statement of ownership and address; the number and date of United States registration; and a Spanish translation of the particular description of goods as stated in the certificate of registration.

Volume of Business in the Patent Office.—The business of the Patent Office for the last six months was the heaviest for any half year in its entire history. The receipts for applications for patents amounted to $45,005, as compared with $42,607, $37,143 and $31,568 for the first six months of the years 1920, 1919 and 1918. The receipts for applications for trade-marks totaled $8,369 in this time, as compared with $7,940, $5,447 and $3,730 for the corresponding periods of 1920, 1919 and 1918. The gain in applications for patent received in the half yearly period just closed over the first six months of 1918 was 42½ per cent, while the gain in trade-mark applications amounted to 124 per cent. In spite of the industrial depression the amount of business presented to the Patent Office in every branch has constantly increased since the year 1918, and in leaps and bounds. The demands upon the Patent Office are beyond any previous figures in its history, with no recession in sight, and are far in excess of the capacity of its limited and practically stationary force to properly handle.

Canadian Patents.—A report of the Canadian Commissioner of Patents recently published shows a very great increase in the number of applications filed for Letters Patent. During the fiscal year 1912 the patent applications filed numbered 8293; during the fiscal year 1920 the patent applications numbered 11,198, and for the fiscal year ending March 31, 1921, 15,446 patent applications were filed. The activity of inventors is a pretty good barometer of the industrial progress which is being made and the filing of a great number of patent applications is evidence of commercial growth. This is so, for each group of inventions is a step forward in the effort which is being made to make this a happier world, and patent applications would not be filed on the inventions unless a valuable return on the patent grants was reasonably anticipated. When considering the report it is very interesting to learn to what extent residents of the United States are patenting their inventions in Canada as a preliminary to the extension of their commercial enterprises in that country. During the last fiscal year 7744 patents were granted to residents of the United States as compared with 1645 patents which were granted to Canadian residents.

Presumption Against Infringement Because of Grant of Patent.—The Patent Office, in passing upon an application for patent never takes into consideration the question of whether or not the subject-matter of that application infringes any existing and unexpired patent. The sole questions determined by the Patent Office are those of novelty, usefulness and operativeness, and patentability. Naturally a great many entirely valid patents are issued, the subject-matter of each of which may infringe one or more of the claims of an earlier and broader patent. However, from time to time the courts have held that the grant of a patent raises a presumption of non-infringement of the invention covered thereby, though of course such presumption may be rebutted by the actual fact of infringement. Frequently the inventor who does not understand the situation is of the opinion that because the Patent Office has granted him a patent he is free to make, use and vend the invention without liability for infringement. Despite the fact that the courts have at different times held that there is such a presumption of non-infringement, owing to the issue of a patent, many prominent patent attorneys are of the opinion that there is no real warrant under our patent practice for such a holding. Nevertheless the Supreme Court of the United States itself (Hildreth vs. J. M. Mastoras, 51, October Term, 1921, decided, November 7, 1921), recently said: "The Circuit Court of Appeals held that the issuing of the Langer patent after the Dickinson patent raised the presumption of a patentable difference between that patent and the Dickinson patent, and against infringement. It is not necessary for us, however, to discuss that question, for we think that whatever presumption against infringement may attach to the issuing of the second patent, if any, the evidence here is quite sufficient to overcome it."

Farmers' Trade-Marks.—Attention has recently been directed to the use and registration of trade-marks by farmers for their products. That such trade-marks are registrable has long been the practice. There are certain requirements, however, that must be met as in the case of other sorts of names used as trade-marks under the Federal trade-mark law. The farm name, for one thing, must be used by the farmer as a trade-mark on his products that he ships to points outside his own State; in other words, a commodity that moves in interstate commerce. It must be printed, stamped, or otherwise attached to each parcel or to the wares. The Federal law makes no provision for the registering of names used as trade-marks on commodities that are shipped only within the State. Although it is thought advisable, it is not necessary that the names be arranged into any distinctive design. Under the trade-mark act of 1905 it was not possible to register a name that is merely geographical, or merely descriptive, or is merely a surname not displayed in some particular or distinctive manner. Such marks, however, can be registered under the act of 1920 if they have been in use by the applicant in interstate commerce for not less than one year. In this way Congress sought to give recognition to a common-law right in a name used as a trade-mark on the ground of its use. Officials of the Patent Office point out that the names of varieties of seeds or plants can not be trade-marked. For instance, a seed grower may develop a variety of watermelon, which he chooses to call the "Excelsior," and to sell the seed as such. Even though the seed goes into interstate commerce its name can not be registered and any buyer who reproduces that variety of seed can sell it under the same name. "Excelsior" is the name of the variety, it is pointed out, and no matter who produces it the seed is still of that kind, and can be offered for sale as such by any one producing it. This also applies to strains and breeds of livestock.

The Importance of Preserving a Trade-Mark Unchanged.—A trade-mark is, in fact a trade signature, for in most cases the trade-mark is the only means by which a retail purchaser may identify the merchandise which is offered for sale. When this means for identifying the merchandise is changed confusion often arises in the mind of the purchaser, and this is especially true when the merchandise is offered for sale in a foreign market. Of course, a manufacturer is not likely to change his label in what he may consider to be its important features, but that which may seem to be immaterial when considered by a group of men, with more or less the same point of view, is sometimes looked on as such a material change by other people under different conditions and in another environment that the merchandise on which the modified labels are used is not recognized as the merchandise which has built up a favorable reputation in the past. While one person when looking at a trade-mark label will be attracted by a particular feature, another person may overlook the said feature entirely, as his attention will be fixed on quite another feature shown on the label. Still another person will have fixed in his mind only the general arrangement as shown. It will therefore be seen that if the said features are altered or removed from the label, or if the general arrangement is changed, some of the manufacturers' customers may be confused when attempting to purchase goods similar to those previously used. Not only is the above true with reference to the difficulty of the retail public in recognizing the trade-mark label when altered, but very often a material change in a trade-mark label raises a question of trade-mark infringement. In many cases a change is made which removes the only feature which distinguishes the trade-mark from a label used by a competitor, and sometimes the rearrangement of the features on a label, or the inclusion of a new feature, so changes the trade-mark as a whole that it so closely resembles the label of a competitor that confusion is sure to arise. There is still another reason why trade-mark labels should not be altered when a manufacturer is offering his goods for sale in foreign countries, for a public unfamiliar with the English language will often fix its attention on a word or other feature which is relatively unimportant to one acquainted with our language and environment, but which, because of some resemblance or suggestion to a foreign word or situation, is perhaps the only feature which will readily remain fixed in a foreigner's mind. It is also necessary to consider the fact that in some of the foreign countries the laws require that a trade-mark be used in the exact form in which it is registered.

Condition of Patent Office Work.—The serious condition of the work of the Patent Office was recently pointed out by Commissioner Robertson in a statement showing that the arrears of work in the Office have increased from 15,000 applications two years ago to more than 56,000 applications at the present time, the Office running behind about 400 applications a week. This situation is due to the very large increase in the work of the Patent Office and the numerical inadequacy of the Patent Office personnel, which, in turn, can be very largely ascribed to the insufficient pay under the present law. Obviously, highly trained and specialized workers, such as Patent Office Examiners, can do far better for themselves by leaving the Patent Office and entering private practice. The result of the existing conditions is that in about 2½ years the Patent Office has lost one-half of the Examining force by resignation. The obvious solution is better pay and an increased force. It is to be hoped that the bill already passed by the House and now pending before the Senate, to remedy the situation, will become a law without delay.

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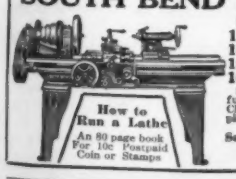

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Notes and Queries

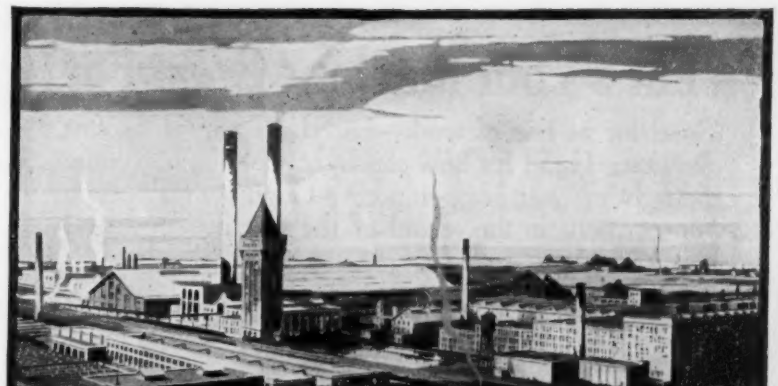
The Notes and Queries column is maintained for the benefit of our readers who desire information on subjects germane to the scope of the paper, together with technical formulas and similar information. Matters requiring profound research or searches in a library cannot be undertaken. In connection with Notes and Queries proper, we maintain a "Service Bureau," which is able, in nearly all cases, to supply addresses of manufacturers whose articles have sufficient novelty and merit to be illustrated in the news pages of this periodical. Correspondents are requested to write their inquiries in all cases, making the subject of the letter entirely separate from the correspondence relating to patents, subscription, books, etc. This will greatly facilitate the answering of these questions, which in many cases have to be referred to experts. The full name and address should always be given. Our full "Hints to Correspondents" will be gladly mailed on request. All letters are answered by mail and only a very few of them can be printed in the limited space at our disposal.

(14379) W. A. R. asks: At some time in the near past, while reading a scientific magazine, I saw where a number of scientists had taken a quantity of platinum, one pound if I remember correctly, and had stretched it into wire 1800 miles long. It was so thin as to be almost invisible, and to prevent breaking it was covered with gold. I told this to the class, but was ridiculed for what they thought an absurd statement. Will you verify the above statement? or will you, if it is untrue, tell me what is the greatest length to which one pound of standard platinum can be stretched? A. Platinum wire has been drawn so fine as to be invisible excepting when held in strong light. The light reflected from it could be seen. It was not drawn quite in the manner you describe. Nor do we suppose a pound of it was ever made. It is used in the eyepieces of telescopes for the cross wires to locate the line of collimation through the center of the field. This wire was made by drawing the platinum directly by the draw plate till it was as thin as it would hold. This fine wire was then plated with silver by electroplating and the compound wire was then drawn to the limit of its strength. After this the silver was dissolved off by nitric acid, leaving the platinum wire as we have described it. It could still sustain several grains.

(14380) N. L. T. asks for a rubber rust protector. A. A solution of pure unvulcanized rubber in benzine has been used for years as a coating for steel, iron and lead, and has been found a simple means of keeping them from oxidizing. It can be easily applied with a brush, and it is as easily rubbed off. It should be made about the consistency of cream.

(14381) A. A. H. asks: Can you give me principal dates of the invention of the cycle, which I need for a paper that I am preparing? A. Four-wheeled velocipede invented in France by Blanchard and Magurier in 1779; pedals applied to a tricycle by a Dumfriesshire blacksmith, McMillan, 1834; rubber tyres for iron, 1868; bicycles made in England by Coventry Sewing Machine Co., 1869; improved by J. K. Starley, 1874; Starley's "Rover," with nearly equal wheels, 1885; first C. club in world, Pickwick Bicycle Club, fd. in London, 1870; Cyclists' Touring Club, 1878; cycles first manufactured in America by A. A. Pope, 1878.

(14382) J. E. K. says: I would be greatly obliged if you can afford me details of an experiment performed in England. A chemist asserted the success of the experiment which had to do with demonstration of theory of the ultimate composition of matter, and declared it a widely known fact that under the influence of radioactivity gold had successively been degraded through lead, iron, etc., to hydrogen and then into negative ions and finally into intangibility. A. We have not noticed, even in the daily newspapers any such announcement of the transmutation of metals as you describe, much less in the scientific papers. Had it taken place we can but believe it would have had large headlines in all the papers. We wait for further particulars, and mark the item "Interesting, if true." Now, the electron theory, upon which this story is based, considers the electron to be the unit of the material of the universe, and that of it, all things consist. The hydrogen atom contains about 1000 electrons. Other elements contain more in proportion to their atomic weights. Oxygen has 16 times as many, or 16,000, and uranium has 238,500 of these particles in its atoms. Now radium has been known to give off particles which became helium. There are other evidences that there is a foundation for the belief held by many scientists that the various elements are thus related to each other and it is possible that hydrogen is the original "stuff" out of which the universe was built. But we do not believe that any man has unscrambled the universe in the manner which you describe. The last step is inconceivable. When everything had been evolved backward into hydrogen, it is unthinkable that this mass of hydrogen could by a wave of the wand be made to pass into nothingness.



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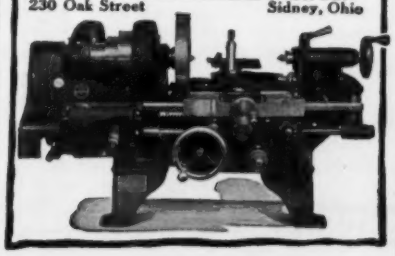

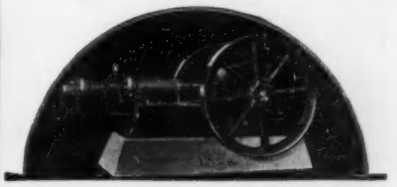

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The large Set-Back Revolution Counter at right is less than ½ actual size. The small Revolution Counter below is shown nearly full size.

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The Liquid Chemical Dustproofer and Wearproofer of Old and New Concrete Floors

Continental Can Co., Chicago, Ill., writes:
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Standard Oil., (Indiana) Minneapolis, Minn., writes:
"Lapidolith has proven very satisfactory but we have used Lapidolith for the past five years constantly."

Chalmers Knitting Co., Amsterdam, N. Y., writes:
"We are pleased to learn by experience that Lapidolith is all you claim for it."

Bethlehem Steel Co., Lebanon, Pa., writes:
"The application of Lapidolith at our plant is entirely satisfactory."

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the modern wood preservative gives new life to old or new wooden floors.

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the protective roof coating for all kinds of worn or new roofs. Saves labor and material cost of new roofs.

SONNEBORN

Recent Advance in Lighting

(*Continued from page 27*)

mirrors and reflect images of light-sources into the visual field even though the sources are hung high.

In the design of fixtures for stores, offices, and similar fields there has been a strong tendency toward dust-proof fixtures. As a result a number of fixtures are available with enclosing glassware of ingenious design. They possess clear and diffusing areas properly located so that the lamp is screened from view but there are clear areas for the emission of light. Such units, if well designed, are more efficient than a mere enclosing globe of diffusing glass. Installations of such units have widely multiplied during the past few years, illustrating the rapid advances in lighting. In the design of such a fixture it is also aimed to have the clear areas in such a position that dust cannot easily settle upon them. Attention is also given to the design of ventilated fixtures in order that they may not be dust-traps. The importance of dust-proof fixtures is apparent when it is realized that the output of a lighting installation in an average location may decrease 25 per cent if not cleaned for a few weeks.

Ten years ago, if one lived in the country out of reach of electric service, as most farmers did, the acetylene plant was the only isolated lighting plant available. During the past few years a number of country-home electric-lighting plants have been developed. These generally consist of a gas-engine, an electric generator, and a storage battery. These plants have been very widely installed during the past few years and have reached beyond the frontier as far as Kodiak Island, Alaska. What cheer science has brought to those long winter nights!

The number of outlets in the modern electrical home has greatly increased recently. A few years ago wall-switches and convenience outlets were rare. In fact, in any large city today there is only about one base-board outlet per residence on the average. Today the middle-class home is not properly wired without 15 to 30 such outlets.

There is still a tendency among fixture manufacturers to use unshaded frosted lamps or glassware which is insufficiently diffusing. Glare is the result, and as the public becomes acquainted with the finer things in lighting it demands subdued light-sources.

With the advent of the modern tungsten lamps it has become possible to produce accurate artificial daylight of sufficiently high efficiency to be practicable. Of course, science hopes for the day to come when daylight quality will be produced directly by the light-source, but until that day arrives the modern color-matching units will do the work required. Now accurate artificial noon-sunlight and north skylight are available through the development of glass color-filters. Such units have been widely installed where accurate color-discrimination is necessary. The public finds them in stores, where merchandise can be examined as to color without going to a door or window; but the layman little realizes that Liberty bonds are examined under them, that dyers depend upon them when dyeing millions of dollars worth of textiles, that the artist paints under them, that cigars are sorted under them, and that they are serving in hundreds of other ways.

Color is gradually coming into its own in lighting, as it has long ago in other fields, but owing to the lack of lighting artists it is not generally used in the best manner. With the advent of the gas-filled tungsten lamp it is now possible to obtain colored light of adequate intensities; however, the lamp colorings which were satisfactory for the vacuum lamp do not withstand the heat of the gas-filled bulb. Only recently have superficial colorings been developed for this purpose, therefore various colored media have been devised as accessories. Colored glass plates and caps, also colored gelatines, are now being used in show-windows to obtain colored light. In the larger moving-picture theaters spectacular effects of colored light are to be seen. Much can be done by the lighting artist who understands what might be termed the language of color.

Colors have many phychological influences which can be utilized. A theater in the summer-time seems cooler if illuminated by blue-green light instead of ordinary light. Conversely, a warm tint, such as that of the candle-flame, makes an interior more cheerful except in very hot weather. It is beginning to dawn upon users of light that light is an expressive medium of great potentiality. It can produce a certain mood in a room which can be altered instantly by switches. This realization is evidenced in modern homes, restaurants, theaters, show-windows and many other places by the many lighting effects which are installed.

It is interesting to note that in many of the elaborate signs of the great white ways the lamps of low wattages are rapidly being replaced by large gas-filled tungsten lamps. Many signs which were designed for 10-watt lamps now contain 75-watt lamps. This is evidence that light is gaining in prestige even in advertising. No better indication of the widening interest in lighting is available than that of lighting legislation. Until recently laws contained at best only meager and incidental references to lighting. Today several states have separate codes pertaining to factory, school, and emergency lighting and there are many laws pertaining to automobile headlights. These codes show that proper and adequate lighting is a great factor in the prevention of accidents and in the conservation of vision. Even insurance companies are contemplating a lower rate of insurance in factories which are well lighted, for, as one of the insurance experts has put it, "during a one-year period in this country the number of accidents due to inadequate or improper lighting exceeds the yearly rate of our casualties in the recent war." Owing to the lack of proper and adequate lighting over 100,000 men are continually absent from work in this country owing to disability. Thus it is seen that even though science contributes much toward the production and distribution of light, there still remains the necessity of an awakening on the part of the public to proper utilization of these developments.

Liquefying Coal

At the Chemical Congress recently held in Stuttgart, the well-known technical expert, Dr. Friedrich Bergius, gave an interesting account of an important new process devised by him and his associates by means of which it is possible to transform gas oil, crude oils containing large percentages of asphalt (*e.g.*, Mexican petroleum), etc., almost completely into light oils without the formation of coke.

The development of this transformation of heavy oils into light oils, such as benzine and gasoline, has been considered one of the most important problems presented to petroleum technologists. At the present time in this country the light oils used for driving motors are prepared by the so-called cracking processes, which are based upon the fact that when the crude oils are heated at a high temperature under increased pressure, the heavy oils break up into light oils, this action being accompanied by the formation of coke and gaseous hydrocarbons. One of the best known of the cracking processes is that formulated by Burton. This is suitable, however, only for medium heavy oils, especially for gas oil, since in the case of very heavy oils and of those rich in asphalt there are serious losses of gas and coke, and also because the large amount of coke formed introduces technical difficulties. For these reasons the cracking process is not applicable to those oils which contain large amounts of asphalt, though these constitute a large part of the world's output.

The formation of coke during the cracking process is due to the separation out of hydrogen and of gases rich in hydrogen during the process of heating. Consequently many attempts have been made during the last few years to overcome this difficulty by the introduction of hydrogen, and naturally catalytic methods suggested themselves as appropriate for this purpose. Since, however, it was found impracticable to make use of catalysers for the hydration of impure crude oil, it was necessary to devise a special method of accomplishing this reaction.

In 1913 such a method was devised in the laboratory of Dr. Bergius, a method, that is, for preventing the impoverishment of the oils in hydrogen during the cracking process. This is accomplished by performing the cracking in the presence of hydrogen under a high degree of pressure. With a sufficiently high pressure and a suitable temperature, it was found easily possible to obtain the desired effect without the presence of catalysers.

Dr. Bergius states positively that this reaction has been found applicable to the most various kinds of oils, oil residues, and even to coal. It is this principle upon which is based the commercial technical process known as the Bergin process. This process can also be adapted to such products as brown coal or lignite generator tar. The loss of material through the formation of gas is trifling; moreover, by suitable alterations in the duration of the reaction, greater or smaller amounts as desired of benzine and petroleum may be obtained.

Because of this adaptability of the process, the crude oil can be broken up at will into light or medium products, according to the demand of the market at any given time.

Dr. Bergius goes still farther. He states that by the use of this same method of operation the hydration and liquefaction of mineral coal is possible. Berthelot, indeed, proved that coal is reducible, by treating the carbon with hydriodic acid.

Because of the experiments made by Dr. Bergius and his colleagues with regard to the production of coal from cellulose and the resultant views formed by them as to the chemical nature of coal, they came to the conclusion that under the proper conditions a reaction could be obtained between coal and hydrogen. Such a reaction was discovered in the summer of 1913 and a patent was applied for on August 9th of that year—it is described as follows:

By heating coal in the presence of hydrogen under a pressure of 100 to 200 atmospheres, the coal can be almost entirely decomposed. If the proper conditions of operation be observed, about 85 per cent of a specimen of coal yielding 85 per cent of ash can be liquefied.

It was necessary, of course, to spend years of work in order to obtain a practical method of making use of this brilliant achievement. The first commercial plant for this purpose has been erected in Mannheim-Rheinau during the last year or so.

Convincing proof has been given, says Dr. Bergius, that the very great difficulties at first encountered in the endeavor to obtain a practical commercial development of the results obtained in the laboratory, are capable of being overcome and that if the high pressure apparatus required be properly constructed the process is both simple in operation and certain in results from the commercial point of view.

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Miscellaneous Notes

Can This Killer Be "Converted"?—The German submarine "U-20," that sank the *Lusitania* and later was driven ashore off Jutland, may be converted into a seaside restaurant.

Cremation Not Fashionable in Paris.—The Paris crematorium may have to close down. Similar institutions in Hungary are thriving, but Parisians cling to the customs of the old church.

Toy Balloons for Golfers.—These are not for the benefit of those who find the regulation ball too small to hit; they are floated over the flags to guide golfers unfamiliar with the course.

The Alhamabra Under Repair.—By government order the famous Alhambra, the most beautiful example of old Moorish architecture, is to be thoroughly restored.

A Permanent World's Fair.—Paris plans to house such a fair in a ten-story building with a 35-story tower. It is to be a permanent exhibition of the whole world's industries and their products.

Senator Penrose as Showman.—Senator Penrose is putting a stage and motion picture outfit in his Washington apartments. He will give two shows a week for invited guests; the first will be George Arliss in "Disraeli."

Business as Usual While Traveling.—The German railway administration purposes to install business offices on trains, including folding tables and typewriters, for the use of traveling men of affairs.

College Men's Earning Power.—What is the average income of the college graduate ten years after leaving college? As indicatd by the income tax reports of the 1911 class of the University of Chicago it is $5,762; the lowest income was $360.

Tea Imports from Japan.—In 1918 Japan sent to America 50,000 tons of tea; in 1920, 30,000 tons; and in 1920 dropped to 23,000 tons. India and Java black teas seem largely to have supplanted Japan's on the American market, and 1921 is expected to disclose a further decrease of from 30 to 40 per cent.

Leaky Torpedoes in Our Navy.—No, it is not a defect in construction. Each torpedo carries as fuel two gallons of first-grade alcohol, and it was found that members of the crew were relieving them of this "load." Officers have decided that better care must be kept of the key to the cellar.

Paris Still a "Fast" City.—With nothing worthy the name of systematic traffic regulation, Paris allows her taxicabs and cars to race wildly about, utterly regardless of pedestrians. In 1920, the number of accidents was 60,375, an average of 165 a day. Paris evidently has no equivalent for the term, "Safety first."

A New Use for the Fireless Cooker.—The fireless cooker may often be used to advantage when setting bread sponge or dough to rise. Sponge requires an even temperature of 60 to 75 degrees F., and dough from 80 to 86 degrees. Use the cooker for this purpose in very hot or very cold weather, determining its temperature with a thermometer.

Our Foreign-Trade Perversity.—An American found in a Java store many American canned goods, and was told these were well liked; but that it was improbable that they would continue to stock them after European trade routes became normal, since the canners refused to put the products in the smaller-size, liter cans that the Javanese demand.

Arkwright's Spinning Jack.—The Science Museum, South Kensington, has just acquired the only known specimen of the original Arkwright spinning jack, which has been in the Swain family for 150 years. It has 48 spindles, and is worked by hand with a 5-foot wooden flywheel. Arkwright, after attempting perpetual motion, completed in 1768 a machine for spinning cotton thread.

Men as Plow-Horses.—In war-ridden Mexico, and particularly in the State of Morelos, horses are scarce. The Government has recently dispossessed the twenty-two landlords who practically owned the whole State, and has apportioned the land in small tracts to laborers. It is a common sight to see men harnessed to plows, and their efforts to increase the productivity of this fertile region are said to be meeting with deserved success.

A Forward Step in Horology.—The new Horological Institute of America perfected its plans in a conference held in New York. With the cooperation of the National Research Council the Institute hopes to promote the science of timekeeping, develop a system of horological schools, install practical courses in manual training schools, provide satisfactory means for the certification of watchmakers, and unite into one national organization all persons interested in the art. Headquarters will be in Washington, and branches will be established in all important centers.

Oriental Trade School on Wall Street.—A new field for New York University is opened with the Division of Oriental Commerce and Politics, which will train its pupils in Eastern ways and seek to develop an invincible combination of the diplomat and the business man. This will put at the service of our smaller enterprises the facilities and methods of which our greatest commercial interests have long availed themselves. It is impossible to exaggerate the benefits accruing to us if we can put our commercial relationships with the teeming millions of Asia on a sound and friendly basis.

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Scientists believe that they were; they call him the "Dawn Man," and out of the record embedded in the rocks they have reconstructed the conditions of his life. How he killed his food and tore the raw flesh from the bones; how he married and fought and died! How little by little he clawed and clubbed his way up to mastery over the beasts. It is a fascinating, gripping story, but it is only one of a thousand stories that stir your blood in this greatest book of modern times.

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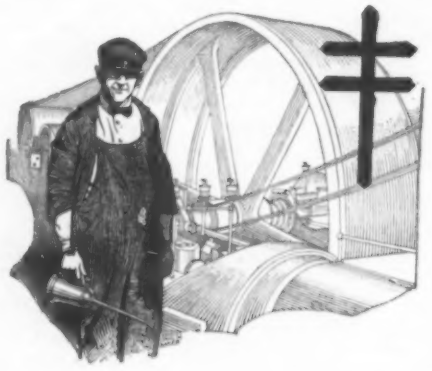

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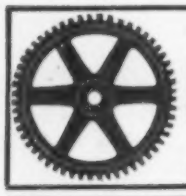

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The Mechanism of the Psychic

(*Continued from page 60*)

number of pieces of apparatus already in general use—hypnotic wheels, revolving mirrors, biometers, sthenometers, photographic and X-ray apparatus, scales and balances for weighing tests, a kymograph for taking graphic records, as well as various pieces of apparatus devised by French investigators (Boirac, Joire, Fortin, Puyfontaine, Thore, Count de Tromelin, Baradue and others). We have also duplicated the apparatus of Sir William Crookes and some of Dr. Hare's. We have Dr. Alrutz' famous board, which apparently registers the pressure of the human will. We have several devices for testing unconscious muscular action on the part of the subject. We have much ordinary electrical and psychological apparatus, suitable for general laboratory work. We have a dictaphone, to which we have attached an amplifying apparatus, so that sounds which occur during a séance or in a "haunted house" may be recorded and magnified. We have galvanometers, by means of which we can test the psychic, and record the psycho-galvanic reflexes, as suggested by Mr. W. Whately Smith. We have various luminous screens, which are said to glow with increased brilliancy in the presence of an added energy or an "astral body." We have a delicate electrical apparatus, designed to test the vital radiation from the finger-tips. We have an electrically controlled apparatus, which will at once indicate any added or subtracted electric energy, either in the medium's body, or in the body of any individual member of the circle. We also have constructed an electrical device which will emit an audible sound when any body approaches it, so that, if no *physical* body is in the immediate proximity of the apparatus, and it emits its characteristic sound, we may presume that some invisible body is approaching it.

It is my hope that we may be enabled, the coming winter, to undertake some researches upon the human aura, by means of some new apparatus which we have planned, and also experiments in weighing and photographing the body, at the moment of death, and in recording radiations emitted by living and possibly by dead bodies. If our endowment is sufficient, I hope that we may also be enabled to construct and test out the elaborate apparatus devised by Drs. Matla and Zaalberg van Zelst, of Holland, and also to duplicate Dr. Grunewald's ingenious apparatus.

It is my belief that much may be gained by attempts to *duplicate*, by artificial means, certain spiritistic and psychical phenomena, and in this manner to ascertain the possible relations or connections between these phenomena, and other physical or electrical phenomena, better known. All advance in science is made by dovetailing the unknown into the known, and showing their possible connections. It is the same here. In attempting to duplicate certain psychic phenomena, we may at least discover some useful analogies which may guide further investigation. A number of experiments along this line are more or less definitely formulated and will presumably be made as opportunity arises. Of these it is perhaps not in order to speak here. One experiment I must mention in some detail, however, because it has actually been performed. It should of course be repeated many times by many other investigators; nevertheless the results obtained in our first performance are sufficiently curious and thought-provoking to deserve statement.

We all know of the old lifting game, in which four persons lift a fifth, seated in a chair, by placing their fingers under the arms and knees of the seated person. All four persons doing the lifting bend forward several times, in unison, inhaling and exhaling deeply together. The person seated in the chair also inhales and exhales at the same time. On the fifth count (say) all five persons hold their breath; the fingers of the four lifters are rapidly inserted under the arms and legs of the seated subject, and the lift is made. It is a fact, which practically everyone will attest, that, under these circumstances, the person lifted seems to lose weight. A heavy man, whom it is found impossible to lift at first, will be lifted with apparent ease upon the lifters' four fingers, after the breathing and bending exercises have been taken. That is the subjective impression of the lifters. The question of course is: Is there *really* any loss of weight, or is this simply a subjective impression?

Although this test has been tried by many thousands of persons, it is curious that no one ever seems to have thought of putting the matter to the test by trying it upon registering scales, upon which the combined weight would, every moment, be in evidence. This test we undertook. On the afternoon of July 25, 1921, we tried this experiment a number of times upon the platform of one of the large, self-registering scales of 2000-pound capacity. This scale had been especially adjusted with the greatest exactitude for our test, and its accuracy was checked off before and after the experiment.

Those doing the lifting were: Mr. William Russell, of our laboratory; Mr. Burling Hull, conjuror; Mr. Albert Poyner, of the Toledo Scales Company; and myself. The subject lifted was Miss Kay MacCausland. The reader of the weights recorded during the various lifts was Mr. W. J. Mahnken, an engineer of the scales company.

A chair was placed in the center of the weighing platform. Upon this the subject to be lifted was seated. The four lifters took up their positions upon four corners of the platform. Our combined weight was 712 pounds. Movements upon our part produced only slight oscillations of the recording needle. Deep breathing produced almost no appreciable effect.

Under these circumstances, the necessary bendings and breathings were undertaken. On the fifth count, the lift was made—slowly, lasting about five seconds. On the first lift the recorder stated that the needle on the dial had fallen to 660 pounds—a loss of 52 pounds! On the second lift, there was an apparent loss of 52 pounds. On the third, fourth and fifth lifts, of 60 pounds. These losses tallied with the subjective feelings of the lifters, who also felt that weight had been lost. How account for these remarkable results?

If I lifted a chair, while standing upon the platform, the dial first of all showed a sudden increase of weight, then a lessened weight, and finally swung back to normal. If I "squatted" on my toes, and suddenly rose to an upright position, a similar gain and then loss of weight was observed. In our lifting tests, however, no gain of weight was at any time reported, invariably a loss, which, however, slowly returned to normal as the subject was held for some considerable time in the air. I have no theory to offer as to these observations, which I cannot fully explain. I merely give the facts as recorded, hoping that others may check off our results and discover what freak in the laws of mechanics was responsible for the results we obtained. It is at all events most curious that these apparent losses of weight coincided with the subjective feelings of the lifters.

This brief summary will at all events, I hope, show the problem before us, as we have formulated it. We desire not only to study mediums (though we should of course be most glad to study them, if available!) but also to duplicate and reproduce psychical phenomena by electrical and physical means, and to conduct varied experiments upon subjects in hypnosis, sleep, trance and other induced states. It is our hope that we may, in this way, be enabled to discover some facts of considerable interest and importance, which will serve, not only to throw light upon psychical and spiritistic phenomena, but which will also tend to show the relations, should they exist, between these manifestations and others, better understood. The ultimate for which we dare hope would be to succeed in proving the existence and showing the nature of a subtle energy, active within the body and radiating from it—an energy upon which many phenomena depend, and which may be, in fact, the vehicle of mind itself. It is hardly necessary to say that this discovery, if ever made, would constitute one of the most fundamental and important and far-reaching conclusions of modern science.

This discussion comprises an abstract, made by the editors, of parts of my address before the recent International Congress of Psychic Research in Copenhagen.

Salt Enough to Bury Land One and One-half Miles Deep

THE Biblical inquiry, "Ye are the salt of the earth: but if the salt have lost his savour, wherewith shall it be salted?" figuratively speaking, can be successfully answered by the sea if the waters will only yield their contents. The ocean contains enough seasoning material to form a block of salt measuring 4,800,000 cubic miles.

More graphically expressed, perhaps, is the measurement which indicates that there is sufficient salt in the vast bodies of waters to form a crust more than one and one-half miles deep over the entire surface of the United States, barring Alaska. Or, expressing the volume of saline matter present in the sea in a third form, one per cent of the seasoning contents of the ocean would envelop the dry lands of the universe to a depth of 290 feet.

Some imaginary calculations, you exclaim! No, these are the figures of the Geological Survey of the United States Department of the Interior, and perchance any discrepancies are found kindly to inform the statistician of this Government bureau. His business involves the keeping tab, numerically speaking, on things pertaining to the earth—whether it be salt or gold. He lives, moves, and virtually has his being in cold-blooded figures.

By the same token, the Geological Survey reasons that each person in the United States was allotted 130 pounds of salt during the past year—assuming the improbable condition of each individual partaking of an equal amount of seasoning in his or her food. The production of salt in 1921 was 6,965,188 short tons, valued at $30,589,166. Not all salt is for table use, however, for there are a variety of ways of consuming the product: Preserving meat, curing fish, hides, dairying, refrigerating, making glaze on pottery, enameling, making pickles, and salting live stock.—*By S. I. Winters.*

Power Gas from Sewage

RECENT experiments at Birmingham have shown that it is practical and economical to drive a suction gas engine from gas derived from sewage sludge. The pump installation comprises a 34-horsepower horizontal gas engine of the ordinary suction type, a 5-inch-diameter centrifugal sludge-pump, and other parts. The engine is capable of giving 34 brake-horsepower at 250 revolutions per minute with town gas having a heat value of 500 to 550 British thermal units per cubic foot. In tests made with sewage gas, from 27½ to 32 horsepower maximum have been obtained.

The principal constituents of sewage gas are methane, hydrogen and nitrogen and carbon dioxide, the per cent of marsh gas varying in various places investigated in accordance with local conditions. The volume of wet sludge dealt with at Birmingham is estimated at not less than 400,000 tons per year. J. D. Watson (*Engineering*, Sept. 23, 1921,) estimates that from this sludge 9000 tons of dry solid matter are available to produce 320,000,000 cubic feet of gas equal to 16,000,000 horsepower-hours, equivalent to 4400 horsepower per day of 10 hours.

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